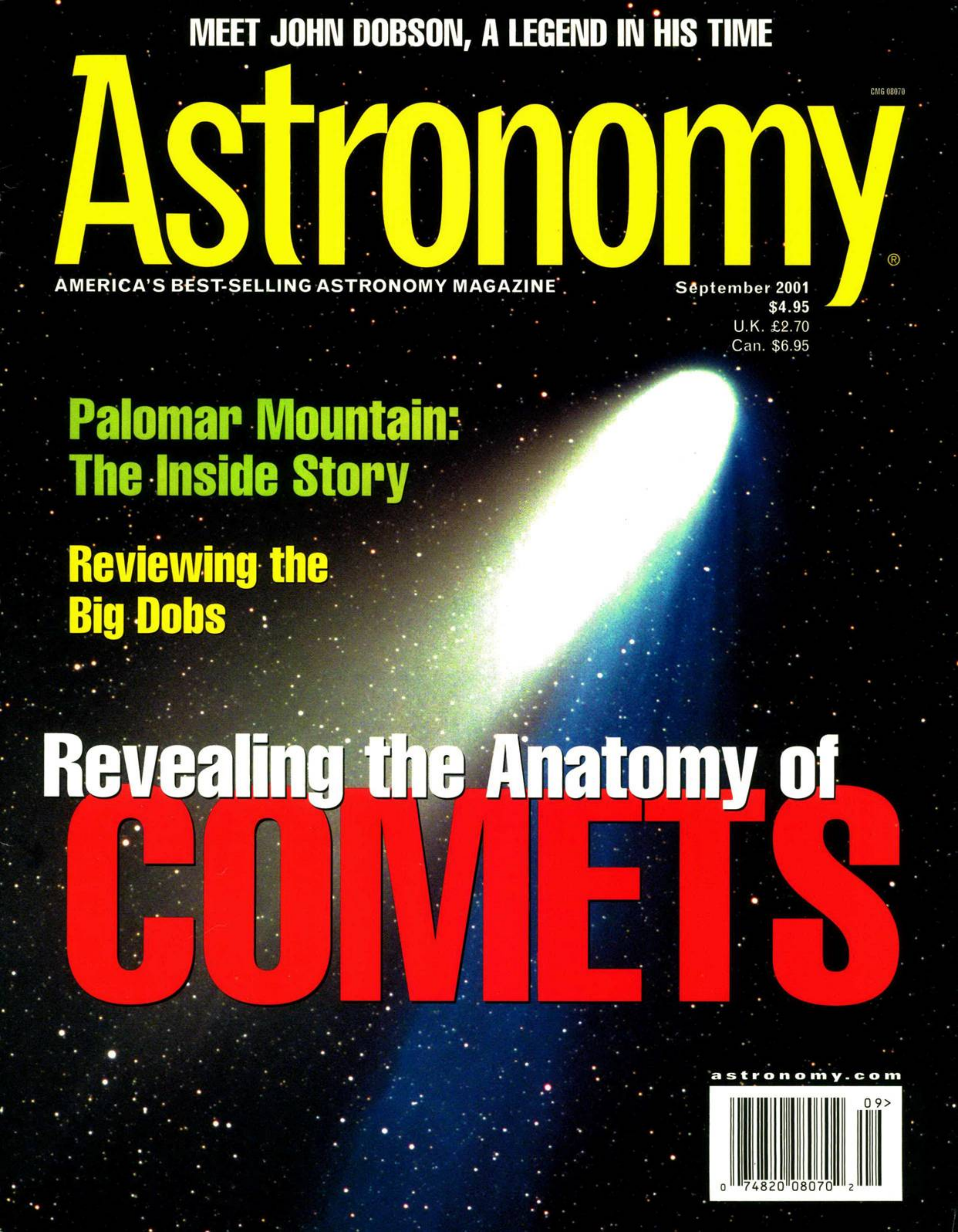
MEET JOHN DOBSON, A LEGEND IN HIS TIME

CMG 08070

Astronomy®

AMERICA'S BEST-SELLING ASTRONOMY MAGAZINE

September 2001
$4.95
U.K. £2.70
Can. $6.95



Palomar Mountain: The Inside Story

Reviewing the Big Dobs

Revealing the Anatomy of COMETS

astronomy.com

MEADE® LX200

7" • 8" 10" • 12"

THE TELESCOPE STANDARD OF THE WORLD

With their large object databases, fast slewing speeds, and uncanny pointing precision, Meade LX200's are recommended for those amateurs who intend an extensive program of CCD imaging, astrophotography, or deep-space observing.

Superb Optics: With oversize primary mirrors for greater full-field illumination, LX200 diffraction-limited imaging capabilities are a legend in the industry; we regularly receive reports stating that optical performance approaches that of a fine *ED* apochromatic lens.

Automatic GO TO Capability: Meade LX200's place objects **dead-center** in the field of view, first time, every time, to a pointing precision of **2 arc-minutes or better,** or, with Meade exclusive High Precision Pointing, to a precision of **one arc-minute or better.** *Meade LX200's are the only commercial telescopes ever manufactured that automatically GO TO any input R.A. and Dec., or to any object in the onboard database of 64,359 objects, to these levels of precision.*

Permanently-Programmable Smart Drive™ routinely achieves 5 arc-sec. periodic error, an observatory standard.

9-Speed Dual-Axis Electronics: Electronics that cover every contingency of telescope positioning — from 2x photo-guide, to 32x image centering, to 8°/sec. slewing across the sky, plus 6 other dual-axis drive speeds in between.

Rigid LX200 Dual-Tine Fork Mountings with Dual 5.75" Worm Gears are the choice of advanced observers, CCD imagers, and astrophotographers for their most sensitive applications.

Full Long-Exposure Capability: Meade LX200's have been the instruments of choice in **thousands** of the most detailed long-exposure images ever taken by amateur astronomers.

Strong Field Tripods: Every LX200 includes a fully adjustable steel field tripod perfectly suited to the sub-arc-second resolution of the telescope's optics.

8" LX200
Schmidt-Cassegrain
$2295

Packing and shipping in the 48 states:
8"—$105; 10"—$145; 12"—$215; 7"—$125.
Prices shown are suggested U.S. mail-order retail prices.

SPECIFICATIONS: 7", 8", 10", and 12" LX200's — Each complete telescope includes 8" or 10" (f/6.3 or f/10) or 12" f/10 Schmidt-Cassegrain or 7" f/15 Maksutov-Cassegrain optical tube assembly with EMC super multi-coatings; heavy-duty fork mount with 4" polar ball bearing, dual-axis 5.75" worm gears, and multi-function control panel; manual and electric slow-motion controls on both axes; keypad hand controller with digital readout display, permanently programmable Smart Drive, 9-speed drive controls on both axes (7-speed on 12"), High-Precision Pointing, and GO TO controller; 64,359-object onboard celestial software library; 25 ft. power cord and adapter for telescope operation from 115v.AC (optional #1812 Electronic DC Adapter allows for field powering directly from an automobile cigarette lighter plug); 8 x 50mm viewfinder; 1.25" diagonal prism (7", 8", 10") or 2" diagonal mirror with 1.25" adapter (12"); Series 4000 Super Plössl 26mm eyepiece; standard field tripod (7", 8", 10") or giant field tripod (12"); operating instructions.

10" LX200
Schmidt-Cassegrain
$2695

12" LX200
Schmidt-Cassegrain
$3995

7" LX200
Maksutov-Cassegrain
$2795

New 2001 126-page Meade General Catalog!
Call, write or fax for your free copy.

ADVANCED PRODUCTS DIVISION
Meade Instruments Corporation
The largest-selling telescopes in the world. ■ *A NASDAQ® company.*
6001 Oak Canyon, Irvine, California 92618 ■ (949) 451-1450
FAX: (949) 451-1460 ■ *www.meade.com*

© 2001

Buy a Meade LX200 Schmidt-Cassegrain and receive $600 in Meade premium-grade Super Plössl eyepieces absolutely FREE!

Buy a Meade LX200 Schmidt-Cassegrain between May 15, 2001 and August 15, 2001 and receive a full set of Meade SP 6.4, 9.7, 12.4, 15, 20, 32, and 40mm eyepieces — plus the SP26mm included as standard equipment with every LX200 — free of charge.

Now you can buy a Meade 7", 8", 10", or 12" LX200 Schmidt-Cassegrain telescope — the largest-selling serious telescopes in the world — **and receive a full set of Meade premium-grade Super Plössl eyepieces absolutely free!** Purchased separately, these eyepieces sell for $599.65.

Designed and manufactured to utilize the very latest in optical glasses, Meade Super Plössls deliver wide 52° apparent fields (44° for the SP40mm) with all the resolution, edge-of-field image sharpness, and color correction demanded in the most advanced visual applications. All eyepieces are multi-coated and include soft rubber eyeguards. In combination with the diffraction-limited optics of a Meade LX200, use the Super Plössls at eight magnification levels to observe hairline lunar and planetary detail, split close binary stars, or study tenuous structure in faint nebulae and galaxies.

Each Super Plössl eyepiece is packed in an individual thread-on poly container to keep the eyepiece clean and secure for long-term storage.

How to Order

1. Buy a Meade 7", 8", 10", or 12" LX200 telescope from any authorized Meade dealer in the U.S.A. between May 15, 2001 and August 15, 2001. (See opposite page for specifications.)

2. Fax or mail a copy of your dealer's invoice (showing the telescope's serial number) to Meade Instruments/Attn: Customer Service, and request the "Free $600 Eyepiece Offer." *Requests for this special eyepiece offer must be postmarked not later than August 31, 2001, and must include your complete shipping address and phone number.*

3. We will ship your free eyepiece package to you within 30 days of our receipt of your request. Meade Instruments will pay for all shipping and insurance charges; safe arrival is guaranteed. This special offer is valid only for new LX200 telescopes ordered and received within the U.S.A.

AUTHORIZED MAIL-ORDER DEALERS

ASTRONOMICS, Norman, OK.
Orders: 800-422-7876; Info.: 405-364-0858.

FOCUS CAMERA, Brooklyn, NY.
Orders: 800-221-0828; Info.: 718-436-6262.

LUMICON, Livermore, CA.
Orders: 800-767-9576; Info.: 925-447-9570.

OCEANSIDE PHOTO & TELESCOPE, Oceanside, CA.
Orders & Information: 800-483-6287.

POCONO MOUNTAIN OPTICS, Moscow, PA.
Orders: 800-569-4323; Info.: 570-842-1500.

RIVERS CAMERA, Dover, NH.
Orders: 800-245-7963; Info.: 603-742-4888.

SHUTAN CAMERA & VIDEO, Chicago, IL.
Orders & Info.: 800-621-2248; IL: 847-367-4600.

EFSTONSCIENCE, Toronto, Ontario, Canada
Orders & Information: 416-787-4581.

KHAN SCOPE CENTRE, Toronto, Ontario, Canada
Orders & Information: 416-783-4140.

September 2001 • Vol. 29, No. 9

Astronomy®

COVER PHOTO: Comet Hale-Bopp; photo by Jerry Lodriguss

FEATURES

COVER

32 **Chasing a Comet**

When a spacecraft encounters Comet Borrelly this month, get ready for the unexpected. *William Speed Weed.*

38 **Probing the Birth of Starlight**

Discovering how stars shine by nuclear fusion was just one of the highlights of Hans Bethe's career. *Adam Frank.*

46 **Keepers of the Night**

Come along for a behind-the-scenes tour of Palomar Mountain, the most storied observatory in the world. *Robert Naeye.*

68 **On the Road with John Dobson**

The tireless pioneer of large-aperture telescopes and inventor of the mount that bears his name is, in his early 80s, still going strong. *Rosemary Sullivant.*

74 **Who Let the Dobs Out?**

Discovery Telescopes' 12.5-inch reflector and the 15-inch model from Obsession Telescopes both offer great power for viewing deep-sky objects in a portable, elegant package. *Phil Harrington.*

80 **Ask Astro**

The editors of *Astronomy* answer your questions about the sky and the universe.

74 Letting the Dobs Out

Astronomy: William Zuback and James Forbes

68 The Legendary John Dobson

Raleigh Souther

32 Catching Comets

Leo Enright

DEPARTMENTS

56 The Moon Prepares for a Show

John McNeal

6 Behind the Scenes
- Meeting John Dobson

14 Talking Back

20 AstroNews
- Science Flows from Sloan Survey
- A Square Dance in Space
- Cosmic Models Match Reality
- Listening for Meteors
- Of Starbursts and Black Holes
- By the Light of the Moon?
- Speedy Delivery?

56 Sky Show
- The moon occults Saturn on the 10th, creating a rare show that photographers will be sure to catch. *Martin Ratcliffe and Alister Ling.*

84 Star Stuff

Products
- Send Rover on Over

Books
- Life Beyond Earth
- Mars: The Lure of the Red Planet
- Voyage to Mars: NASA's Search for Life Beyond Earth
- The Cambridge Dictionary of Space Technology

78 Looking Ahead

99 Advertiser Index

103 Hot Shots
- Cactus Flowers Point to the Stars

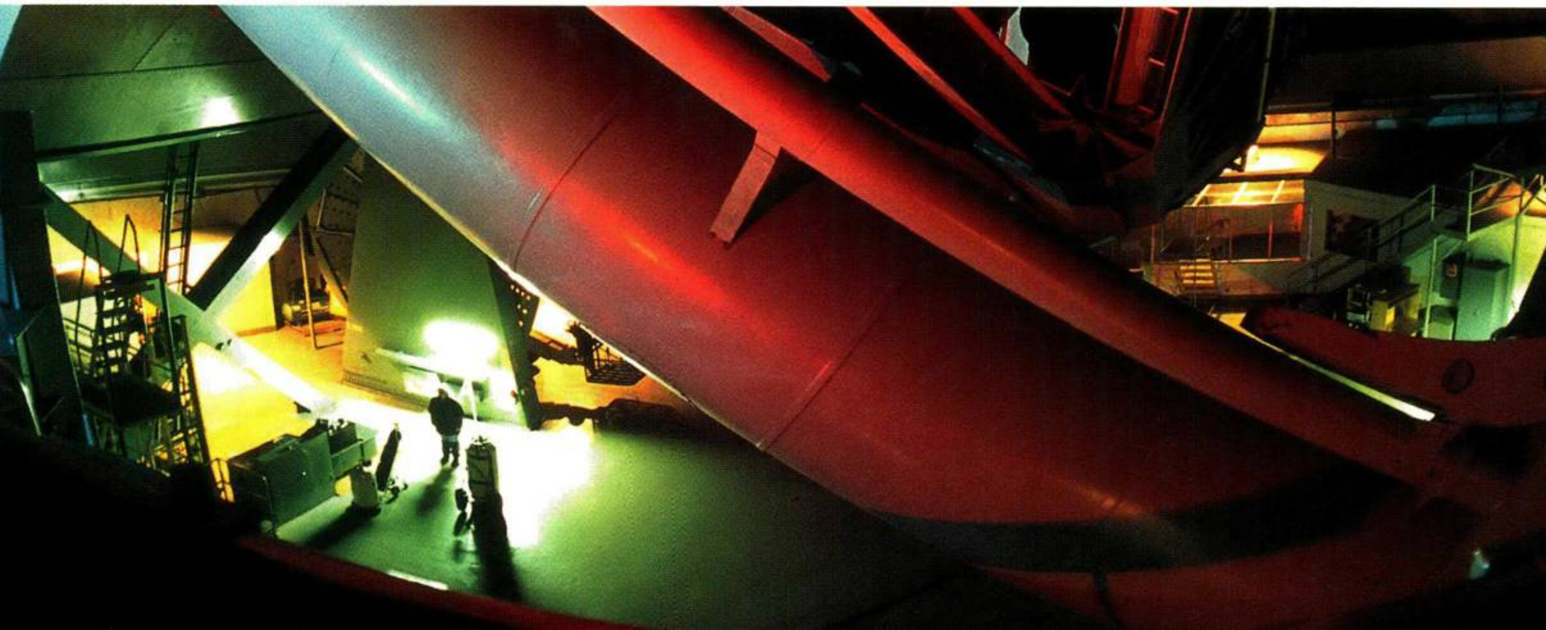
112 Ultimate Exposure

38 Discovering Starlight NASA/STScI

20 Hot Galaxy News

NASA/STScI

46 A Trip to Palomar Mountain Raleigh Souther



BEHIND THE SCENES

BY BONNIE BILYEU GORDON

Meeting John Dobson

John Dobson pulls up in a battered-up old station wagon with a homemade telescope on top and slams on the brakes. He jumps out of his car, presumably dressed in monk drag. In the 1950s John was a practicing Buddhist monk who lived in a San Francisco monastery, but he was so smitten with astronomy that he used to sneak out in the evenings and drive around looking for people with whom he could share a view of the night. (He'd probably get himself arrested in a hot minute these days, because he was on a constant lookout for kids, who are often most open to new experiences.)

I try to imagine what it would have been like walking around San Francisco, a city my family and I regularly visited in those years, and bumping into John Dobson and his station wagon after dark. I was a child who never spoke to strangers, but perhaps my parents would have encouraged me to take a peak through the telescope, particularly if others were already gathered around it. In my imagination, this Pied Piper of dark skies always drew a crowd, as he does still at (almost) age 86.

John spoke at the recent meeting of the Riverside Telescope Maker's Conference, this year called RTMC Astronomy Expo (in an effort to attract more than simply astronomers who make their own scopes.) He told us once again about his idea of cosmology, which is accepted by almost no one. His theory rests somewhere between the Big Bang and the now out-of-date theory for Steady State cosmology. I've heard his talk twice and I still don't understand some of the finer points (though part of the fault may be mine). I, like many of his greatest fans, am always eager to hear him tell about how he was thrown out of the monastery or describe in rich detail the making of an early scrap-crafted telescope. His talk on cosmology is his favorite topic but I'd like to hear more about his earthly adventures. The Riverside crowd listened to him with careful attention. Most listeners agreed with me, but they hold Dobson in such high regard that they are always respectful.

Terry Conley

John Dobson shares a solar telescope at *Astronomy* magazine's 25th anniversary star party in 1998 in New Mexico. During the day, he helped build a Dobsonian telescope that was raffled at the party.

John Dobson has done many marvelous things to promote the growth and well-being of amateur astronomy, as you will learn in Rosemary Sullivant's story about him on page tk. Maybe he just deserves to have his say on the beginning of the universe in his own time.

Astronomy®

EDITORIAL STAFF

EDITOR
Bonnie Bilyeu Gordon
MANAGING EDITOR
David J. Eicher
SENIOR EDITORS
Rex Graham, Richard Talcott
ASSOCIATE EDITORS
Carol Ryback, William Schomaker
COPY EDITOR
Elesa Janke
PHOTO EDITOR
Kelly Kizer Whitt
EDITORIAL ASSOCIATE
Terry Williams Conley
EDITORIAL ASSISTANT
Julie Sherwin
CONTRIBUTING EDITORS
Robert Irion, Ray Jayawardhana, Patricia Kurtz, Beth Livermore, John Shibley, Tom Yulsman

ART STAFF

ART DIRECTOR
Carole Ross
GRAPHIC DESIGNERS
Chuck Braasch, Beth Wesselhoff
ILLUSTRATOR
Elisabeth Rowan
PRODUCTION COORDINATOR
Helene Tsigistras

EDITORIAL ADVISORY BOARD

Buzz Aldrin, Marcia Bartusiak, K.C. Cole, Timothy Ferris, Adam Frank, Paul Hodge, John S. Gallagher III, Anne L. Kinney, Edward Kolb, Alan Lightman, Stephen P. Maran, Boyce Rensberger, James Trefil

ASTRONOMY.COM EDITOR

Andrea Gianopoulos

Astronomy **HOME PAGE**
http://www.astronomy.com

ASTRONOMY (ISSN 0091-6358, USPS 531-350) is publishe
monthly by Kalmbach Publishing Co., 21027 Crossroads Circl
P.O. Box 1612, Waukesha, WI 53187. Editorial phone: (262) 79
8776; advertising: (888) 558-1544; customer service & sale
800-533-6644; outside the U.S. and Canada: 262-796-8776, ex
421, Monday through Friday, 8:30 A.M. to 5 P.M. CT, Fax: (26
796-1615; E-mail: customerservice@kalmbach.com. Pleas
include your name, mailing address, and telephone numbe
with any correspondence. Copyright © 2001 Kalmbac
Publishing Co., all rights reserved. Material in this publicatio
may not be reproduced in any form without permissio
Periodicals postage paid at Waukesha, WI, and addition
offices. Printed in the U.S.A. Allow 6 to 8 weeks for new su
scriptions and address changes. Subscription rate: sing
copy: $4.95; 1 year $39.95, 2 years (24 issues) $74.95, 3 yea
(36 issues) $106.95; Canadian & foreign: 1 year $50, 2 yea
$95, 3 years $137. Payable in U.S. funds drawn on U.S. Bank
(Canadian price includes GST.) Expedited Delivery Servic
Surcharges: Domestic 1st Class $30 per year, Canadian a
$30 per year, Foreign air, $60 per year. BN 12271 3209 RT. Cana
Post Publication Agreement Number 545-775. Not responsib
for unsolicited materials. POSTMASTER: Send addres
changes to ASTRONOMY, 21027 Crossroads Circle, P.O. Box 161
Waukesha, WI 53187-1612.

LX10

MEADE 8" LX10

NOW WITH FREE FIELD TRIPOD FOR A LIMITED TIME!

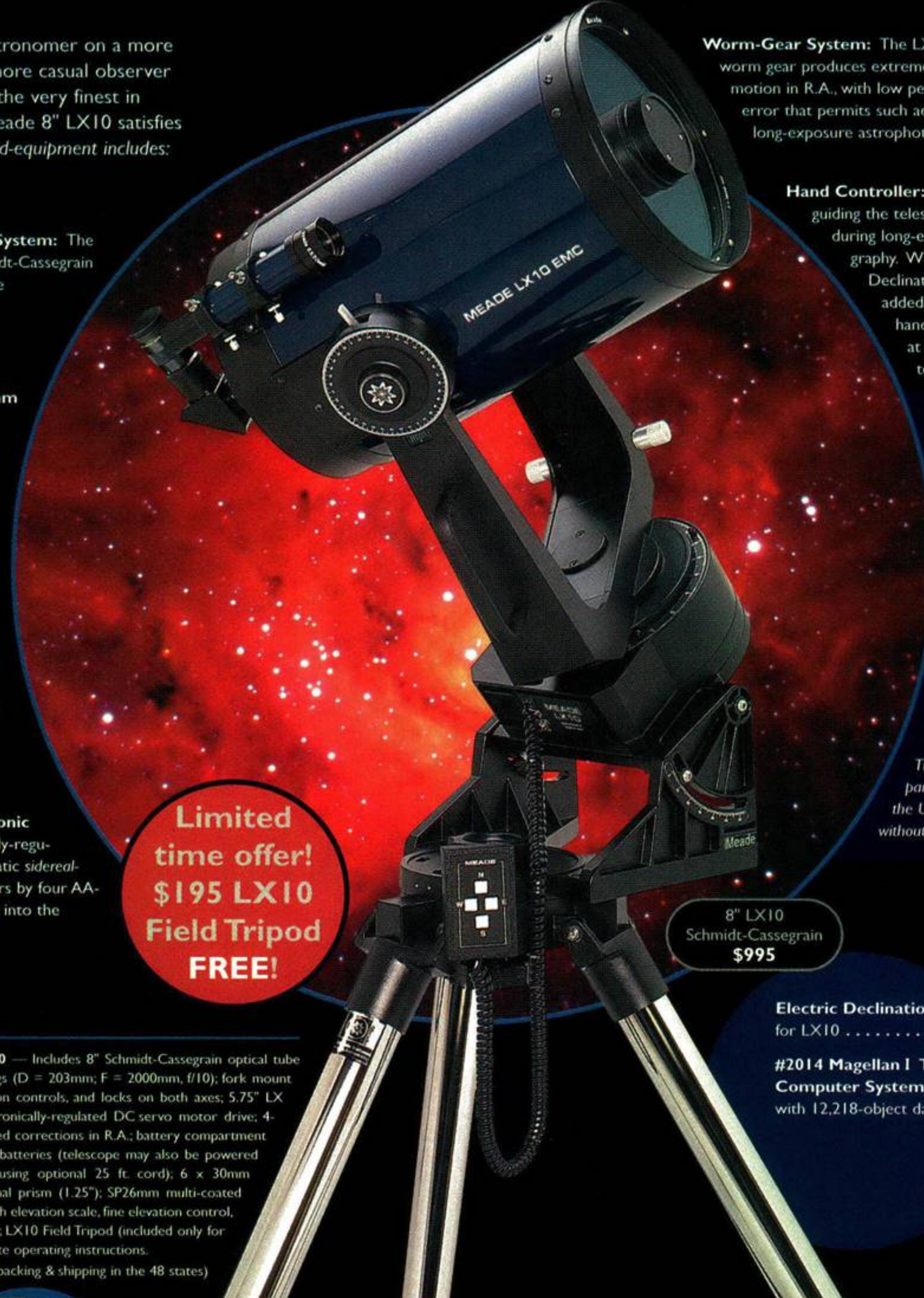
For the serious amateur astronomer on a more limited budget, or for the more casual observer who nonetheless demands the very finest in optical performance, the Meade 8" LX10 satisfies every requirement. *Standard-equipment includes:*

Super-Multi-Coated Optical System: The *exact same* multi-coated 8" Schmidt-Cassegrain optical tube assembly as the more expensive Meade 8" LX200.

Series 4000 Super Plössl 26mm eyepiece: An $80 eyepiece, the SP26mm complements the exquisite imaging of Meade 8" Schmidt-Cassegrain optics.

Equatorial Fork Mounting: The relatively light weight, but very stable, LX10 fork mounting provides all of the rigidity required for sensitive high-power visual applications of the telescope, or for photographic or CCD imaging.

Cordless, DC-Powered Electronic Motor Drive: With electronically-regulated DC servo motor for automatic *sidereal-rate* tracking; powered for 50 hours by four AA-size batteries that fit conveniently into the telescope's control panel.



Limited time offer! $195 LX10 Field Tripod FREE!

Worm-Gear System: The LX10's 5.75"-diameter worm gear produces extremely smooth, regular motion in R.A., with low periodic error — a periodic error that permits such advanced capabilities as long-exposure astrophotography or CCD imaging.

Hand Controller: Essential for micro-guiding the telescope in R.A. at 2x speed during long-exposure astrophotography. With the optional electric Declination motor *(see below)* added to the telescope, the hand controller is functional at 2x speeds on both telescope axes.

LX10 Field Tripod: The chromed steel LX10 Field Tripod provides an extremely rigid platform for visual and photographic observations with the telescope. Regularly $195, this tripod is included **free of charge** for a limited time with your purchase of the 8" LX10 telescope.

This free offer is valid at participating Meade dealers in the U.S.A. and may be cancelled without notice at any time.

8" LX10
Schmidt-Cassegrain
$995

Electric Declination Motor System for LX10	**95.**
#2014 Magellan I Telescope Computer System for LX10 with 12,218-object database	**375.**

SPECIFICATIONS: 8" Model LX10 — Includes 8" Schmidt-Cassegrain optical tube assembly with EMC super multi-coatings (D = 203mm; F = 2000mm, f/10); fork mount with setting circles, manual slow-motion controls, and locks on both axes; 5.75" LX worm gear system; sidereal-rate electronically-regulated DC servo motor drive; 4-pushbutton hand controller for 2x speed corrections in R.A.; battery compartment accepting four (user-supplied) AA-size batteries (telescope may also be powered from an auto cigarette lighter plug, using optional 25 ft. cord); 6 × 30mm viewfinder; eyepiece-holder and diagonal prism (1.25"); SP26mm multi-coated eyepiece; standard equatorial wedge with elevation scale, fine elevation control, and 360° azimuth orientation capability; LX10 Field Tripod (included only for a limited time, as noted above); complete operating instructions.

$995. (+ $65 packing & shipping in the 48 states)

Prices shown are suggested U.S. mail-order prices

New 2001 126-page Meade General Catalog!

Call, write or fax for your free copy.

ADVANCED PRODUCTS DIVISION
Meade Instruments Corporation
The largest-selling telescopes in the world. ■ A NASDAQ® company.
6001 Oak Canyon, Irvine, California 92618 ■ (949) 451-1450
FAX: (949) 451-1460 ■ *www.meade.com*

© 2001

ETX-70AT MEADE **ETX** **FREE TRIPOD!**

THE ETX REVOLUTION STARTS AT $299!

Let Meade® high-resolution ETX® optics and standard-equipment Autostar controller take you on an automated guided tour of the Solar System, the Galaxy, and beyond.

Fork Mount with Dual-Axis Drive System: Precision worm gear systems permit smooth pushbutton motions of the telescope, as well as sidereal-rate tracking in the altazimuth mode.

Standard-Equipment #494 Autostar™ Controller: Includes most of the same features as the more advanced #497 Autostar available for larger ETX models *(facing page)*.

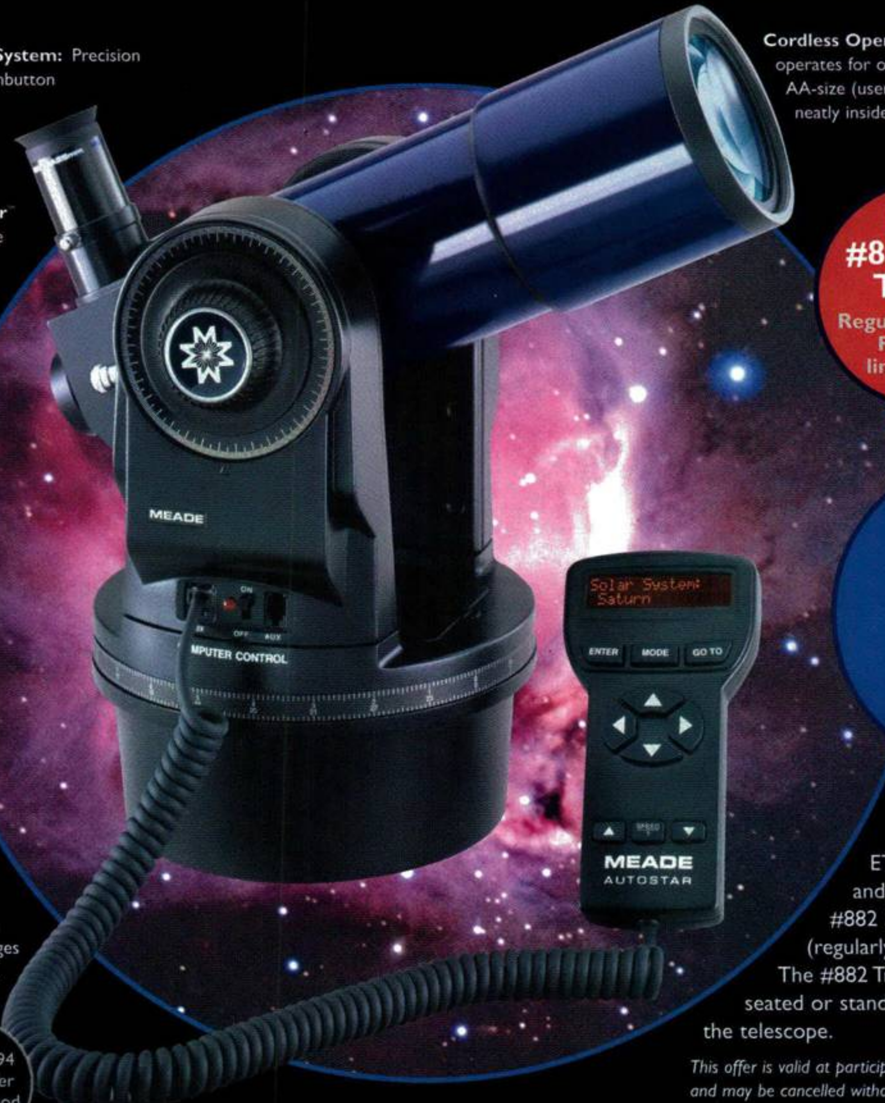
Automatic dual-axis GO TO function at 4.5°/sec. to any of more than 1450 database objects, including the complete Messier and Caldwell deep-space object catalogs, the major planets from Mercury to Neptune, 26 asteroids, 15 periodic comets, and more. Or GO TO *any* object of known R.A. and Dec.

9-speed Dual-Axis Operation: Pushbutton control of the telescope on both axes, simultaneously, at any speed from 2x sidereal to 4.5°/sec., plus sidereal-rate tracking.

High-Resolution Achromatic Objective Lenses of exclusive Meade design; each lens yields razor-sharp images of astronomical and terrestrial subjects.

Flip-Mirror System: Flip the internal optical flat mirror "up" for 90° observing; flip the mirror "down" for terrestrial observing with the optional #933 45° Erecting Prism or for photography with the optional #64ST Photo Adapter.

Cordless Operation: The dual-axis drive operates for over 20 hours in the field from six AA-size (user-supplied) batteries which store neatly inside the drive base.



ETX-70AT, complete with #494 Autostar Controller and #882 Field Tripod
$299

Free #882 Field Tripod!
Regularly $99, now FREE for a limited time!

For a limited time you can purchase a Meade ETX-70AT Astro Telescope and receive a full-length Meade #882 Standard Field Tripod (regularly $99), **absolutely free.** The #882 Tripod is ideal for either seated or standing observations through the telescope.

This offer is valid at participating Meade dealers in the U.S.A. and may be cancelled without notice at any time.

OPTIONAL SYSTEMS FOR MEADE ETX TELESCOPES*

#882 Standard Field Tripod (70)	$99.00	#883 Deluxe Field Tripod (90, 125)	199.95
#827 8 x 25mm Right-Angle Viewfinder (70)	49.95	#825 8 x 25mm Right-Angle Viewfinder (90)	49.95
#773 Hard Carry Case (70)	59.95	#774 Hard Carry Case (90)	99.95
#933 45° Erecting Prism (70)	49.95	#775 Hard Carry Case (125)	149.95
#64ST Photo Adapter (70)	19.95	#932 45° Erecting Prism (90, 125)	49.95
#497 Autostar Computer Controller (90, 125)	149.00	#64 Photo Adapter (90, 125)	34.95
#880 Equatorial Table Tripod (90)	29.95	Electric Focuser #1244 (90) *or* #1247 (125)	119.95
#881 Equatorial Table Tripod (125)	59.95		

**see also the Meade accessory ad in this issue.*

SPECIFICATIONS: ETX-70AT Astro Telescope — Includes achromatic refractor optical tube assembly (D = 70mm, F = 350mm, f/5) with multi-layer optical coatings; internal flip-mirror system for either straight-through or 90° observing position; fork mount with electric slow-motion controls, setting circles, and locks on both axes; electronic control panel; 9-speed (2x sidereal through 4.5°/sec.) dual-axis motor drive system with #494 Autostar computer controller; sidereal-rate tracking; internal compartment accepting six (user-supplied) AA-size batteries; MA9mm (39X) and MA25mm (14X) multi-coated eyepieces; #882 Standard Field Tripod (included only for a limited time, as noted above); operating instructions.
ETX-70AT — $299 (+$10 packing & shipping in the 48 states)

MEADE INSTRUMENTS CORPORATION *The largest-selling telescopes in the world.*

ETX-90EC **MEADE** ETX-125EC

ETX

ENGINEERED FOR THE GROUND UP

Now for a limited time you can purchase the Meade ETX-90EC Astro Telescope — the largest-selling modern telescope in the world — at $495, a savings of $100 off the regular price.

This offer is valid at participating Meade dealers in the U.S.A. and may be cancelled without notice at any time.

MEADE
COMPUTER CONTROL
COMPUTER CONTROL
IN
FOCUS
OUT
SPEED
MODE
MEADE
ETX AUTOSTAR
MEADE
ENTER
MODE
GO TO

Fork Mounts with Dual-Axis Drive Systems: Each with high-torque DC motors on both telescope axes, permitting electronic operation from the standard-equipment plug-in hand controller.

Pushbutton Electronic Hand Controller: Use any of four dual-axis speeds: 8x, 32x, 0.75°/sec., or 5°/sec.

Maksutov-Cassegrain Optical Systems: ETX diffraction-limited optics produce images so high in contrast and resolution that ETX telescopes often outperform other telescopes of larger apertures.

Flip-Mirror System: Flip the internal optical flat mirror "up" for 90° observing; flip the mirror "down" for terrestrial observing with the optional #932 45° Erecting Prism or for photography with the optional #64 Photo Adapter.

Cordless Operation: The dual-axis drive system operates for more than 40 hours from eight (user-supplied) AA batteries.

Optional #497 Autostar™ Now Only $99 (regularly $149) For a Limited Time!

- **Automatic dual-axis GO TO function** at 5°/sec to any of more than 14,000 database objects.
- Select any of Autostar's database objects, or any object of known R.A. and Dec., press ***GO TO*** and the telescope automatically slews to the object.
- **9-Speed Dual-Axis Operation** from 2x sidereal to 5°/sec.

Save up to $150!
ETX-90EC $495
Autostar $99 for a limited time!

ETX-90EC,
complete with
Electronic Controller
$495

ETX-125EC,
complete with
Electronic Controller
$895

SPECIFICATIONS: ETX 90EC and ETX-125EC Astro Telescopes — Each includes Maksutov-Cassegrain optical tube assembly (D = 90mm, F = 1250mm, f/13.8 *or* D = 127mm, F = 1900mm, f/15) with EMC super multi-coatings; internal flip-mirror system for either straight-through or 90° observing position; fork mount with electric slow-motion controls, setting circles and locks on both axes; electronic control panel; 4-speed (8x, 32x, 0.75°/sec, 5°/sec) dual-axis motor drive system with hand controller; sidereal-rate tracking in equatorial mode with optional table tripod or deluxe field tripod; internal battery compartment accepting eight (user-supplied) AA-size batteries; 8 x 21mm erect-image (ETX-90EC) *or* 8 x 25mm right-angle (ETX-125EC) viewfinder; Series 4000 Super Plössl 26mm eyepiece (1.25"); instructions. **ETX-90EC — $495** (+ $20 packing & shipping in the 48 states); **ETX-125EC — $895** (+ $30 P & S).

AUTHORIZED MAIL-ORDER DEALERS

ASTRONOMICS, Norman, OK.
Orders: 800-422-7876; Info.: 405-364-0858.

FOCUS CAMERA, Brooklyn, NY.
Orders: 800-221-0828; Info.: 718-436-6262.

LUMICON, Livermore, CA.
Orders: 800-767-9576; Info.: 925-447-9570.

OCEANSIDE PHOTO & TELESCOPE, Oceanside, CA.
Orders & Information: 800-483-6287.

POCONO MOUNTAIN OPTICS, Moscow, PA.
Orders: 800-569-4323; Info.: 570-842-1500.

RIVERS CAMERA, Dover, NH.
Orders: 800-245-7963; Info.: 603-742-4888.

SHUTAN CAMERA & VIDEO, Chicago, IL.
Orders & Info.: 800-621-2248; IL: 847-367-4600.

KHAN SCOPE CENTRE, Toronto, Ontario.
Orders & Information: 416-783-4140.

6001 Oak Canyon, Irvine, CA 92618. (949) 451-1450. FAX: (949) 451-1460. www.meade.com

© 2001

RESEARCH-GRADE ACCESSORIES

Series 4000™ Super Plössls
52° field; multi-coated

Meade 4-element Super Plössls, updated and redesigned to utilize the latest in optical glass-types, are the finest general-purpose eyepieces available. For observing hairline lunar and planetary detail, splitting close doubles, or for deep-space; guaranteed to deliver more contrast and image sharpness than any other brand. Rubber eyeguards fold down for eyeglass wearers–a feature not available on competing brands. Multi-coated. All focal lengths through 32mm are parfocal.

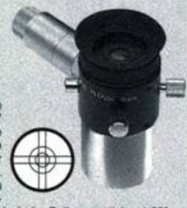
Super Plössls (SP; 4-elements; 1.25"; 52°):
6.4, 9.7, 12.4, 15, 20, 26mm each: **$79.95** (4.54)
32mm (52°); **40mm** (44°) each: **99.95** (5.26)
56mm (52°; 2") **199.95** (7.02)

Series 4000™ Ultra Wide Angle
84° field; multi-coated

The ultimate eyepieces; extreme image sharpness over an amazing 84° field. A perfect optical match with Schmidt-Cassegrains and fast Newtonians.

Ultra Wide Angle (UWA; 8-elements; 1.25"; 84°)– **4.7mm: $169.95** (5.26); **6.7mm: 199.95** (5.26); **8.8mm** (1.25"/2"): **239.95** (7.02); **14mm** (1.25"/2"): **299.95** (7.02)

World's Most Advanced Illuminated Reticle Eyepiece



Series 4000 Plössl 9mm, with rubber eyecup and micrometric X-Y positioning of the reticle within the field. Greatly facilitates locking on the guide star. Sharp high-power imaging, excellent eye relief. Wireless red LED illuminator with adjustable brightness control. Multi-coated optics. **Internal batteries included.** Bullseye reticle. 1.25".
$149.95 (6.14)

Series 4000 Plössl 9mm—Same as above but with 6 ft. cord and plug for Meade LX3, LX5, LX6, LX100, LX200, and APO power panels, in place of wireless illuminator.
$129.95 (5.26)

Series 4000™ f/6.3 Focal Reducer/Field Flattener

Manufactured to exclusive Meade optical designs; threads on to any Meade or Celestron Schmidt-Cassegrain rear cell and converts f/10 scopes to f/6.3 (or f/6.3 SCT's to f/4), while significantly flattening the field. Use with SCT visual or photo accessories. Actual visual field is increased by 56%, for fine wide-field views of star fields and nebulae. In astrophotography, reduces exposure times by about 50%, while producing an actual field diameter of 1.5" at the film plane. A tremendous aid with CCD imagers in reducing image size for locating and centering images on CCD chips. 4-element optics; multi-coated; 41mm clear aperture. **$129.95** (5.26)

Series 4000 Photo-Visual Color Filters (1.25")–Premium filters, made of purest crown optical glass, dyed in the mass. For increased contrast and resolution on the Moon and planets. Thread into the barrels of virtually all 1.25" eyepieces sold today. Fully coated.

#8 Lt. Yellow; #11 Yellow Green; #12 Yellow; #21 Orange; #23A Lt. Red; #25A Red; #38A Dark Blue; #47 Violet; #56 Lt. Green; #58 Green; #80A Blue; #82A Lt. Blue
each **$14.95** (2.73)

Set #1–4 filters: #12, #23A, #58, #80A **49.95** (4.54)
Set #2–4 filters: #11, #25A, #47, #82A **49.95** (4.54)
Set #3–4 filters: #8, #21, #38A, #56 **49.95** (4.54)

Series 4000 Moon Filter (#ND96): Reduces glare and irradiation during lunar observing. 13% uniform light transmission across the visual spectrum. Threads into 1.25" barrels. **$16.95** (2.73)

2x Telenegative Barlow (1.25")

#122: Doubles eyepiece power with sharp, high-resolution, high-contrast imaging on telescopes of all types. 27mm dia. (26mm clear aperture). Excellent corrections for chromatic and spherical aberrations at all photo-visual wavelengths. Multi-coated. 1.25"
$47.95 (4.54)

#905 Variable Polarizer (1.25")

For glare reduction in observing the Moon. Includes two Polarizer filters mounted in a machined cell and permits continuously variable light transmission from 5% to 25%, to compensate for varying lunar surface brightness according to the Moon's phase and the aperture of the telescope. Accepts 1.25" eyepieces. **$49.95** (5.26)

2x Short-Focus Barlow (1.25")

#126: Only 2.5" long, the #126 works well with any telescope accepting 1.25" eyepieces, even those with limited focus range. Maintains the high image quality of the #122, above. Insert the #126 into star diagonal for 2x or insert star diagonal into #126 for 3x. 26mm clear aperture. Multi-coated. **$47.95** (4.54)

2x-3x Variable Barlow (1.25")

#127: Precision internal sliding lens assembly permits continuously variable power settings between 2x and 3x. Engraved scale indicates power in use. Yields bright, sharp, high-contrast images on telescopes of all types. Multi-coated; 1.25".
$59.95 (4.54)

2" Diagonal Mirror

#929: Permits use of wide-field 2" oculars. Threads on to rear cell of Meade and Celestron SCT's. Includes multi-coated precision optical flat made at the Meade factory; with 1.25" eyepiece adapter. **#930:** Same as #929 but with 2" barrel to fit into focusers with 2" eyepiece-holders.
#929 or **#930**, each: **$99.95** (6.85)

45° Erecting Prisms

Fully coated roof prisms to invert the astronomical image in Schmidt-Cassegrains or refractors during terrestrial observations, while presenting a convenient 45° observing angle. Specify **#927** (.965"), **#928** (1.25"), or **#931** (fits .965" focuser, accepts 1.25" eyepieces).
$42.95 (3.86)

Electric Focusers for SCT's

For extremely smooth microfocusing of the image. Does not affect use of the manual coarse-focus knob.

#1206 Electric Focuser: Plugs into control panel of Meade 8", 10", 12" LX200 models and operates from LX200 hand controller. **$149.95** (7.48)

#1205 Electric Focuser: For all other Meade 8", 10", 12" SCT models; includes separate hand controller; accepts one self-contained (user-supplied) 9v. battery.
$169.95 (7.88)

#777 Off-Axis Guider for SCT's

Internal prism diverts light for monitoring telescopic image during long-exposure astrophotography. Threads to any Meade or Celestron rear cell. Use with illuminated reticle eyepiece and T-Mount for your 35mm camera.
$79.95 (6.85)

Series 4000™ 2x Apochromatic Barlow Lens

#140: The most advanced Barlow lens available for commercial telescopes, the Meade #140 includes 3-element, multi-coated, air-spaced optics. Doubles the power of any eyepiece with which it is used and yields images absolutely unmatched in resolution, contrast and color correction. The #140 optically complements any telescope — refractor, reflector, or Schmidt-Cassegrain. Accepts 1.25" eyepieces. Mechanical components are of machined aluminum and brass. Lens diameter is 28mm; clear aperture 26mm.
$79.95 (5.26)

Series 4000™ Super Wide Angle
67° field; multi-coated

For exquisite wide-angle images at low-to-medium powers, with pinpoint edge-of-field resolution. Ideal for star fields, galaxies, and other deep-space phenomena. SWA 13.8mm, 18mm, and 24.5mm are superb complements to the #140 Barlow, above.

Super Wide Angle (SWA; 6-elements; 1.25"; 67°)–**13.8mm: $139.95** (4.54); **18mm: 149.95** (4.54); **24.5mm: 179.95** (5.26); **32mm** (2"): **239.95** (7.02); **40mm** (2"): **299.95** (7.02)

Series 3000™ Plössls
50° field; multi-coated

Meade Series 3000 Plössls yield the finest image corrections obtainable from the classical 4-element Plössl design. Focal lengths from 5mm through 25mm are parfocal, so that, at most, only slight refocusing of the image is necessary from eyepiece to eyepiece. Unlike competing moderately-priced Plössls, Meade Series 3000's are **multi-coated** for maximum light transmission and image contrast. Chrome-plated brass barrels are threaded for standard filters. All eyepieces are fitted with fold-down rubber eyecups for comfortable observing. The PL40mm *(far right in photo)*, an excellent complement to any ocular set, produces spectacular low-power, wide fields, ideal for scanning the Milky Way. Manufactured exclusively to Meade optical designs, Series 3000 Plössls yield fine, high-resolution results on reflectors, refractors, and Schmidt-Cassegrains of any focal ratio.

Series 3000 Plössls (4-elements; 1.25"; 50°)
5, 6.7, 9.5, 16, 25mm each: **$49.95** (3.86); **40mm** (44° field): **$79.95** (3.86)

#911B
#910B
#908B
#911N
#910N
#908N

Series 4000 Nebular Filters—Premium multi-layer interference filters, the finest obtainable. Use broadband ("B") filters to block most forms of light pollution; use narrowband ("N") filters in heavily light-polluted areas or for extremely high-contrast observing of faint nebulae.

#908B–Threads into 1.25" eyepieces, 26mm dia. **79.95** (4.54)
#910B–Threads into 2" eyepieces, 44mm dia. **119.95** (5.26)
#911B–Threads on to rear cell of Schmidt-Cassegrain telescopes. 36mm dia. **99.95** (5.26)
#908N–Threads into 1.25" eyepieces, 26mm dia. **89.95** (4.54)
#910N–Threads into 2" eyepieces, 44mm dia. **129.95** (5.26)
#911N–Threads on to rear cell of Schmidt-Cassegrain telescopes. 36mm dia. **119.95** (5.26)

#911X
#910X
#908X

Series 4000 Oxygen-III Filters Observe diffuse emission and planetary nebulae as you never thought possible! Exclusive Meade *60-layer* interference coating technology isolates the 496nm and 501nm O-III lines to tremendously enhance observable nebular structural detail in all telescopes.

#908X–Threads into 1.25" eyepieces, 26mm dia. **99.95** (4.54)
#910X–Threads into 2" eyepieces, 44mm dia. **159.95** (5.26)
#911X–Threads on to rear cell of Schmidt-Cassegrain telescopes. 36mm dia. **149.95** (5.26)

Modified Achromatic Eyepieces

Meade 3-element MA eyepieces yield sharp, well-corrected images on the Moon, planets, and deep-space at a reasonable price. Multi-coated; threaded for filters; 1.25" barrel diameter. Apparent field: 40°. **MA 9, 12, 25, 40mm.**
each: **$37.95** (4.54)

MA12mm Illuminated Reticle Eyepiece

Excellent 3-element optical system, long eye relief, fully coated, with double crossline reticle; rubber eyecup. Wireless red LED illuminator and variable brightness control. 1.25". **Batteries included.**
$99.95 (3.45)

As above but with 6 ft. cord and plug for Meade telescopes with power panels, in place of wireless illuminator. **$79.95** (5.26)

Camera Adapters

Professional-quality adapters for rigid coupling of telescope-to-camera. Use for either Eyepiece-Projection or Prime Focus. Precision-machined of aluminum and brass, threaded for filters. Use with T-mount, available separately.
.965": $27.95; 1.25": $29.95 (3.86)

Variable-Projection Camera Adapter (1.25")

Machined sliding cell allows variable projection power in eyepiece-projection photography; permits precise selection of correct photo power in lunar and planetary photography; threaded for filters. Use with T-mount for your camera.
$39.95 (3.86)

Variable Tele-Extender

For eyepiece-projection photography with any Meade or Celestron SCT. Threads on to eyepiece-holder. Sliding cell with lock permits wide range of projection magnifications with the same eyepiece. Use with T-mount for your camera.
$39.95 (3.86)

T-Adapters for SCT's

Rigidly couples camera to telescope for prime focus photography with any Meade or Celestron Schmidt-Cassegrain. Use with T-Mount for your 35mm camera.
$26.95 (3.86)

CCD-Photo-Visual Flip-Mirror Systems

An essential accessory for imaging with ***any*** brand of CCD imager or for astrophotography with a 35mm camera. Flip mirror "down" to center the image while viewing with an eyepiece at 90°; flip mirror "up" to pass light on to CCD chip or 35mm camera film plane. Each unit includes: precision optical-flat Pyrex® mirror; 2-axis mirror-adjustment screws and locks for precise image centering; extra-fine helicoid focusing of the eyepiece; extension tubes for attaching either 35mm camera (using T-Mount) or CCD imager (using either T-threads or 1.25" barrel). Threads to rear cells of all Schmidt-Cassegrain telescopes; may remain on telescope and used in place of diagonal prism for visual observing as well.

"Over the past 10 years I have used all manner of flip-mirrors. The Meade Flip-Mirror Systems are absolutely the best—rock solid, high-precision, beautifully manufactured; they virtually eliminate all flexture between the CCD and telescope." — Jack Newton

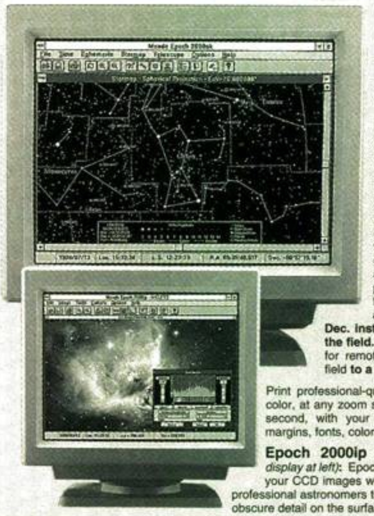
#644 Flip-Mirror System: Accepts any 1.25" eyepiece. Mirror clear aperture: 22mm. Use with CCD's up to Pictor 416XT or ST-7, or smaller; or visual observing with 1.25" eyepieces. **$149.95** (7.02)

#647 Flip-Mirror System: Accepts either 1.25" or 2" eyepieces. Mirror clear aperture: 40mm. Recommended for full-field 35mm astrophotography or with CCD's of any size, including all Meade Pictor Series through 1616XT, as well as ST-4 through ST-8; or for visual applications with 1.25" or 2" eyepieces. **249.95** (8.49)

#157 1.25" Adapter: Permits use of either Flip-Mirror on telescopes with 1.25" eyepiece-holders. (Requires approx. 2" additional focus travel with #644, 3" with #647.) **15.00** (3.86)

#644
MEADE
FLIP-MIRROR SYSTEM

#647
MEADE
FLIP-MIRROR SYSTEM
MODEL 647



Epoch 2000® Sky Software

The most powerful astronomical software ever made available can now be yours for only $149!

Epoch 2000sk *(upper display at left):* Now you can use the most advanced, most precise full-color sky software ever created, to zoom-in on telescopic fields **smaller than one arc second!** With star positions displayed as precisely as **0.01 arc second,** the Trapezium in Orion is no longer shown as a single point, as in other software, **but as four precisely oriented starpoints, just as they appear in the telescope.** No longer do you need to guess the R.A. and Dec. of an object located away from the field center, as in other programs: Epoch 2000sk dynamically reads out the R.A. and Dec. of the cursor position anywhere in the field **and updates R.A. and Dec. instantaneously as the cursor is moved about the field.** Meade LX200 owners can use Epoch 2000sk for remote auto-centering of objects in the telescopic field **to a precision of 30 arc seconds,** routinely!

Print professional-quality star charts in either black-and-white or color, at any zoom setting or sky scale between 180° and one arc second, with your own customized borders, headers, footers, margins, fonts, colors, and grids.

Epoch 2000ip Image Processing Software *(lower display at left)*: Epoch 2000ip makes it easy to enhance and analyze your CCD images with the same sophisticated techniques used by professional astronomers to uncover hidden structure in a spiral galaxy or obscure detail on the surface of a planet. This powerful software includes virtually every technique available for image enhancement. Techniques that bring out detail totally invisible in your original image, transforming it from the ordinary to the spectacular.

EPOCH 2000sk Sky Software: 281,000 objects supplied on 3.5" discs for Windows 3.1 or higher; fully compatible with Windows 95 . . . . **$149**

EPOCH 2000sk-CD Sky Software: 19 million objects, including the complete Hubble Guide Star Catalog; supplied on CD-ROM **179**

LX200 Interface Cable: for Meade LX200 operation by Epoch 2000sk **25**

EPOCH 2000ip Image Processing Software: Supplied on 3.5" discs for Windows 3.1 or higher; fully compatible with Windows 95 . . . . **$199**

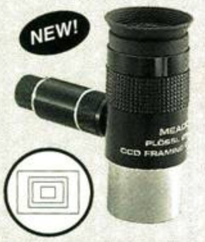
CCD f/3.3 CCD FOCAL REDUCER

Series 4000™ f/3.3 CCD Focal Reducer/Field Flattener

NEW!

Revolutionary 3-element Meade design permits ultrafast CCD imaging with **increased** edge-of-field resolution and color correction! Reduces CCD exposure times by up to 80%. Threads on to the rear cell of any Meade or Celestron Schmidt-Cassegrain. Converts f/10 Schmidt-Cassegrain telescopes to **f/3.3** and f/6.3 SCT's to **f/2.** Variable T-Adapter (included) allows range of f/ratios between f/3 and f/5 on f/10 SCT's and between f/1.9 and f/3.2 on f/6.3 SCT's. Use with CCD imagers of any brand and chip dimensions. Not for visual or photographic applications. Multi-coated; 41mm clear aperture. **$149.95** (5.26)

Plössl 25mm Illuminated Reticle CCD Framing Ocular



Displays rectangular frames of all popular CCD chip sizes, including all Meade Pictor models and ST-4 through ST-8. Shows precisely the image size and orientation that appear on CCD chip. Insert directly into telescope eyepiece-holder, or use with Flip-Mirror *(above)*. Includes 4-element coated Plössl optics; lockable spacer ring to fix focus position; rubber eyecup; variable LED illumination control; batteries. 1.25".

$129.95 (4.54)

#825 8 x 25mm Right-Angle Viewfinder for ETX-90

Permits comfortable right-angle viewing. Replaces standard-equipment finder on 90mm ETX models, using the same bracket. Wide-angle, achromatic, coated optics; actual field 7.5°. Precise helicoid focusing.

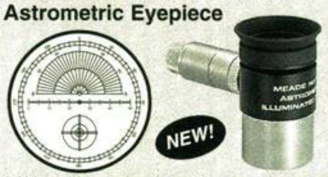
$49.95 (4.26)

#64 T-Adapter for ETX®

Threads to the photo port of all ETX-90 and ETX-125 models. Rigidly couples any 35mm camera with removable lens to the telescope for lunar, planetary, or terrestrial photography. Includes extension tube for longer effective focal length, if desired. Use with T-Mount for your 35mm camera.

$34.95 (3.86)

MA12mm Illuminated Reticle Astrometric Eyepiece



A high-precision eyepiece for a wide range of astronomical measurements. Includes four red-illuminated, laser-etched scales for measuring double star angular separations, position angles, planetary diameters, and lunar crater diameters, and for long-exposure photo-guiding. Modified Achromatic 3-element coated optics; diopter adjustment; rubber eyecup; variable LED illumination control; batteries. 1.25". **$119.95** (4.26)

Series 4000™ 8mm – 24mm Zoom Eyepiece

NEW!

The finest zoom eyepiece available. High-resolution 7-element multi-coated optics, with 55° field at 8mm. Graduated scale in 1mm units indicates exact focal length in use. High-eyepoint yields comfortable observing even with eyeglasses. Internal zoom lenses move on the smoothest, most precisely-machined tracks yet developed for zoom optics. Performance is fully consistent with the finest fixed-focal length eyepieces. Threaded for filters; rubber eyecup; 1.25". **$219.95** (6.38)

ETX® Hard Carrying Cases

For secure storage or travel with your ETX. Thick-wall construction and die-cut foam lining. Accepts telescope, plus optional eyepieces, erecting prism, table tripod, hand controller, *etc.* Includes two steel latches with key.

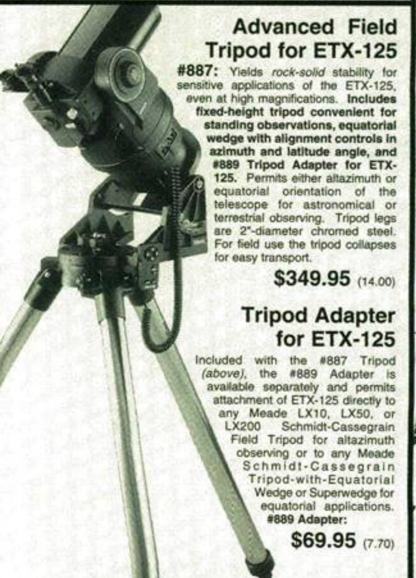
#774 Case for ETX-90 models: **99.95** (8.58)

#775 for ETX-125EC: **149.95** (13.38)

#932 45° Erecting Prism for ETX®

For terrestrial observing with any ETX-90 or ETX-125 model. Yields correctly oriented image and convenient 45° observing angle. Threads to ETX rear cell. Accepts any 1.25" eyepieces. Coated roof prism optics.

$49.95 (3.86)



Advanced Field Tripod for ETX-125

#887: Yields *rock-solid* stability for sensitive applications of the ETX-125, even at high magnifications. **Includes fixed-height tripod convenient for standing observations, equatorial wedge with alignment controls in azimuth and latitude angle, and #889 Tripod Adapter for ETX-125.** Permits either altazimuth or equatorial orientation of the telescope for astronomical or terrestrial observing. Tripod legs are 2"-diameter chromed steel. For field use the tripod collapses for easy transport.

$349.95 (14.00)

Tripod Adapter for ETX-125

Included with the #887 Tripod *(above)*, the #889 Adapter is available separately and permits attachment of ETX-125 directly to any Meade LX10, LX50, or LX200 Schmidt-Cassegrain Field Tripod for altazimuth observing or to any Meade Schmidt-Cassegrain Tripod-with-Equatorial Wedge or Superwedge for equatorial applications.

#889 Adapter: **$69.95** (7.70)

ETX® Deluxe Field Tripod

#883: Custom-designed by Meade specifically for ETX-90 and ETX-125 Astro Telescopes. Tripod height adjusts from 34" to 54", for seated or standing observations. Micrometric controls in azimuth and elevation permit precise polar alignment of the ETX fork mount. Tripod head tilts and locks to 90° for terrestrial applications. Telescope attaches to tripod in seconds with 2 thumbscrews. All-aluminum construction.

$199.95 (10.00)

ETX® Carry Bag

Soft-padded Cordura-type carry bag with shoulder strap; permits storage of any 90mm ETX model, plus table tripod legs, eyepieces, other accessories.

$36.95 (5.26)

NEW!

Electric Focusers for ETX®

ELECTRONIC CONTROLLER
MEADE

Meade-engineered for smooth, rapid focusing with any ETX model. Four-speed operation from coarse to microfine. Standard-equipment hand controller accepts one 9v. (user-supplied) battery and focuses all ETX telescopes. Or focus ETX/EC models through the telescope's hand controller.

#1244 Electric Focuser for all ETX-90 models: **$119.95** (6.85)

#1247 Electric Focuser for ETX-125 models: **$119.95** (6.85)

HOW TO ORDER

Prices shown are suggested U.S.A. mail-order retail prices and do not include any applicable sales taxes. Suggested shipping and handling charges to the 48 states by U.P.S. or U.S. Mail shown in ( ) next to each price. **The following national mail-order dealers carry all Meade accessories in-stock for immediate shipment:**

ASTRONOMICS, Norman, OK.
Orders: 800-422-7876; Info.: 405-364-0858.

FOCUS CAMERA, Brooklyn, NY.
Orders: 800-221-0828; Info.: 718-436-6262.

LUMICON, Livermore, CA.
Orders: 800-767-9576; Info.: 925-447-9570.

OCEANSIDE PHOTO & TELESCOPE, Oceanside, CA.
Orders & Information: 800-483-6287.

POCONO MOUNTAIN OPTICS, Moscow, PA.
Orders: 800-569-4323; Info.: 570-842-1500.

RIVERS CAMERA, Dover, NH.
Orders: 800-245-7963; Info.: 603-742-4888.

SHUTAN CAMERA & VIDEO, Chicago, IL.
Orders & Info.: 800-621-2248; IL: 847-367-4600.

Canada:

EFSTONSCIENCE, Toronto, Ontario.
Orders & Information: 416-787-4581.

KHAN SCOPE CENTRE, Toronto, Ontario.
Orders & Information: 416-783-4140.

© 2000

THE LARGEST-SELLING TELESCOPES IN THE WORLD

MEADE

See these authorized Meade dealers for information on any of forty Meade telescope models, from entry-level telescopes under -$200 to professional instruments over $15,000.

NATIONAL

Meade Telescopes and Accessories are available at
DISCOVERY CHANNEL STORE
Call for location nearest you.
Call **1-800-222-6105**

NATIONAL

RITZ CAMERA CENTERS
Over 1000 Locations Nationwide
Call **800-52-FOCUS** *for nearest location*
www.ritzcamera.com

ARIZONA

Quality Meade telescopes and accessories
Mr. Telescope
20 E. Camelback Rd., Phoenix, AZ 85012
602-955-5521

ARIZONA

Quality Telescope and Accessories
Sky Works®
The Astronomy Drugstore...Get Your R_x Here!
7401 E. 22nd Street, Tucson, AZ 85710
520-751-6752 • fax: 520-751-6758
www.sky-works.com

CALIFORNIA

Studio City Camera
Full-line Meade. Optical expert on staff. Over 50 years' experience selling telescopes!
12174 Ventura Blvd., Studio City, CA 91604
818-762-4749

CALIFORNIA

REED'S CAMERAS
We carry a full line of quality Meade telescopes
1524 Locust St., Walnut Creek, CA 94596
925-934-7207

CALIFORNIA

Claremont Camera & Video
If it's quality Meade telescopes you're looking for – We offer it all!
863 W. Foothill Blvd., Claremont, CA 91711
909-626-2219

CALIFORNIA

Huge Meade inventory at low prices
Woodland Hills Camera
Telescopes • Binoculars
5348 Topanga Canyon Blvd., Woodland Hills, CA 91364
818-347-2270 or toll-free
Buy, Sell **1-888-4-ASTRONOMY** ***Trade***

CALIFORNIA

Largest Meade Display in California!
Boot's Camera
5587 North Blackstone Ave.,
Fresno, CA 93710
559-432-0446

CALIFORNIA

Gluskin's Cameras Audio Video
Largest telescope dealer in the San Joaquin Valley
300 Lincoln Center, Stockton, CA 95207
209-477-5566

COLORADO

Mike's Camera, Inc.
We carry one of the largest supplies of quality telescopes and accessories.

Boulder	Littleton	Denver
303-443-1715	**303-708-9655**	**303-733-2121**

CONNECTICUT

WHOLESALE OPTICS
WWW.ASTROPTX.COM
E-MAIL: astroptx@astroptx.com
Phone Orders 7 Days 9 am - 12 midnight • Sat. Hrs.: 11 am - 5 pm
Showrooms/Business Office:
57 North St., Suite 401, Danbury, CT 06810
Phone: **860-355-3132**

DELAWARE

CUTLER CAMERA
Binocular and Telescope Specialists
Stores in Wilmington, Newark and Dover
403 Branmar Plaza, Wilmington, DE 19810
888-442-8821

FLORIDA

National Camera & Digital Imaging
Competitive Prices! Expert Service! Sales Nationwide! 35 Year Reputation.
1650 North Military Trail, Suite 104
West Palm Beach, FL 33409, **561-689-3155**
Out of State **1-800-9-CAMERA**

FLORIDA

Complete line of fine Meade Products
Kenin Scientific & Optical Products
Big Display and We Do Mail Orders
1830 N.E. 163 St. • North Miami Beach
Phone: **305-940-7804** • Fax: **305-947-5943**

GEORGIA

Camera Bug Ltd.
Atlanta's Leading Telescope and Binocular Dealer. We Ship Practically Anywhere.
1799 Briarcliff Rd., Atlanta, GA 30306
404-873-4513 • Fax 873-3925

MASSACHUSETTS

Full-line dealer! We accept trade-ins! Meade telescopes on display for your inspection!
Harvard Camera
Town of Harvard: **978-456-8100**
e-mail: harvardcamera.com

MICHIGAN

RIDER'S HOBBY SHOPS
Serving Michigan Since 1972
Competitive Discount Prices
For the store location nearest you call **888-530-9780.** Locations throughout Michigan. HTTP://RIDERS.COM

MINNESOTA

RADIO CITY INC.

Full stocking Meade dealer serving the upper midwest. "We can help." radioinc.com

2663 County Rd. I, Mounds View, MN 55112

1-800-426-2891 • 763-786-4475

MINNESOTA

VIRGINIA BOAT 5TH AVE

Meade Telescopes & Acessories - Binoculars Spotting Scopes - Microscopes - Maps

Technicians Available 1:30 to 4:30

205 S. 5th Ave., Virginia, MN 55792

218-741-8994

MONTANA

NIGHT SKIES

Come and see the largest display of telescopes and accessories in Montana.

1550 Amsterdam Rd., Belgrade, MT 59714

Phone: **406-388-1205** e-mail: **nightsky**@wtp.net

NEBRASKA

ROCKBROOK CAMERA & VIDEO

Nebraska's Authorized Meade Dealer

2 Locations:

108th & W. Center Rd.
Omaha, NE 68144
402-397-1171

40th & O St.
Lincoln, NE 68510
402-488-4200

NEW JERSEY

N.J.'s Largest Display of Meade Telescopes.

Dover Photo Supply

25 E. Blackwell St.
Dover, NJ 07801

973-366-0994

NEW MEXICO

PhotoSupply, Inc.

Stocking New Mexico's largest selection of Meade telescopes.

DeVargas Shopping Ctr., Santa Fe, NM 87501

505-982-2585

NEW YORK

EDMUND SCIENTIFIC COMPANY

Call for a free catalog or see our full Meade line in our showroom.

60 Pearce Ave., Tonawanda, NY 14150-6711

1-800-728-6999

NEW YORK

Berger Bros. Camera & Video Exchange

Excellent Advice, Prices and Reputation For 50 Years

209 Broadway (Rte. 110), Amityville, LI, NY 11701

1-800-262-4160 • 631-264-4160

NEW YORK

We have specialized in sales and repair of telescopes for over 20 years! See us for expert advice!

Johnson Camera

6565 Kinne Rd. at Erie, Syracuse, NY 13214

315-446-0290

NEW YORK

B & H PHOTO VIDEO

We carry a full line of quality Meade telescopes

420 9th Avenue, New York, NY 10001

www.bhphotovideo.com

1-800-947-9970 • (212) 444-6670

NORTH CAROLINA

Your quality Meade dealer in North Carolina

Camera Corner

800-868-2462

www.camcor.com

2273 S. Church St., Burlington, NC 27215

sky@camcor.com

OHIO

Pete's PhotoWorld

Competitive Prices! ***Great Service!***
Telescope expert on staff ***Ask for Craig***

Telescope FAQ's www.photoworld.com

7731 Beechmont Ave, Cincinnati, OH 45255

petes@photoworld.com 1-800-736-7383

OHIO

McALISTER CAMERA & VIDEO

Full Line Meade. Reputable Dealer With Competitive Prices. Call Eric For Advice.

588 W. Schrock Road
Westerville, OH 43081 (Columbus)

Phone: 614-794-1865

PENNSYLVANIA

The Camera Shop In Bryn Mawr

Suburban Philadelphia's
Photo & Optical Specialists

572 Lancaster Ave., Bryn Mawr, PA 19010

610-527-0300

PENNSYLVANIA

CUTLER CAMERA

Binocular and Telescope Experts

7 Locations in PA and NJ

Largest Dealer in the Delaware Valley

314 Horsham Rd., Horsham, PA 19044

215-674-5727 • 1-800-220-5727

SOUTH CAROLINA

Wonder Works

Friendly, helpful service!

Open 7 days a week.

280 W. Coleman Blvd., Mt. Pleasant, SC 29464

Toll-Free **888-849-5540**

www.wonderworkscharleston.com

TEXAS

Analytical Scientific

If it's a quality Meade telescope you're looking for, call us.

11049 Bandera Rd., San Antonio, TX 78250

210-684-7373 • 800-701-STAR

http://www.analyticalsci.com

TEXAS

Land, Sea & Sky Unlimited

Complete sales and service of Meade telescopes. We are optical specialists.

3110 S. Shepherd Dr., Houston, TX 77098

713-529-3551

www.neosoft.com/~lsstnr

WASHINGTON

Captain's Binoculars & Telescopes

Optical specialists, not just order-takers. • 2 locations:

2500 15th Ave. West, Seattle, WA 98119
206-283-7242

3333 184th St., S.W., Suite W, Lynnwood, WA 98037
425-670-8797

www.captainsnautical.com

WASHINGTON

Meade Telescopes & Accessories

The Naturium

Kitsap Mall, Silverdale, WA

360-698-3580

WASHINGTON

Anacortes Telescope & Wild Bird, Inc.

3202 Commercial Ave., Anacortes, WA 98221

360-588-9000 • Fax 360-588-9100

http://www.buytelescopes.com

WISCONSIN

EAGLE OPTICS

Authorized Meade Dealer. We've built a nationwide reputation for quality sales and service.

2120 W. Greenview Dr., Middleton, WI 53562

1-800-289-1132

www.eagleoptics.com

CANADA

PERCEPTOR

Friendly Service, Expert Advice, Low Prices, Full Meade Line, Delivery Across Canada

Brownsville Jct. Plaza, Box 38, Suite 201
Schomberg, Ontario L0G 1T0

905-939-2313 • Fax 905-939-8274

CANADA

LA MAISON DE L'ASTRONOMIE

Competitive Prices • Expert Service

8074 St. Hubert, Montreal, Quebec H2R 2P3

514-279-0063 • Fax **514-279-9628**

e-mail: rlotte@interlink.net
http://www.microid.com/maison.htm

Neutrino Wave

In "Ask Astro" (May 2001) Steven Bugler wanted to know how long it would take for the effects to reach us if our sun went supernova. Robert Naeye's response is correct, assuming that the actual starting time of the explosion is the instant that the blast wave reaches the surface of the sun, and that the initial effects of the explosion on Earth result from the increase in the flux of light.

However, some of these effects begin earlier, with the star's core collapse. Such a collapse would create copious amounts of neutrinos that take time to propagate to the surface. But because of their low interaction with matter, neutrinos would escape ahead of the main blast wave.

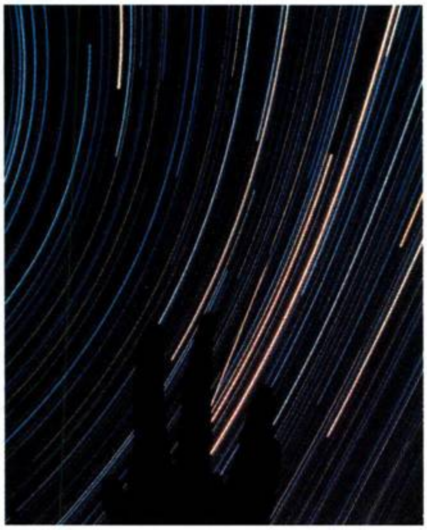
If this is true, then Earth would get blasted with high doses of neutrinos before any visible indications appeared that the sun was exploding. Furthermore, it wouldn't matter on what side of Earth you were when this occurred.

It strikes me as somehow unfair that anyone about to die in a supernova blast would not at least get to experience it (however briefly)! In any event, we are clearly quite fortunate that the sun doesn't actually meet the criteria needed to make a supernova. *— Scott Sandford, NASA, Ames Research Center, Moffett Field, California*

Moon Shot

The caption to Warren T. Parkes's Ultimate Exposure Photo, "Space Shuttle Atlantis Launches into the Florida Sky," (June 2001, page 112) says the bright dot in the lower center of the picture is the sun.

However, in the text of "Hot Shots," Vince Mollichella correctly describes the scene as the shuttle launching right past the moon. Judging by the arc of the shuttle's path, and knowing the launch time — 6:13 P.M. EST — I'd say the photo was taken facing east. What we see is indeed the moon. *— John Webinga, Winter Haven, Florida*



The brief flash of a meteor probably caused this off-track light streak. Eric DeBolt

Stolen Scopes

Roughly twice a year I hear about astronomy equipment that was stolen or misplaced. For this reason, I started a group on Yahoo in order to broadcast notices listing these occurrences.

My goal is to have all amateur astronomers subscribed. By alerting as many observers as possible, the odds of successful recovery will increase dramatically. It's an easy way to prevent losses and recover equipment.

Let's help each other. Please join the group at: http://groups.yahoo.com/group/MissingScope; e-mail, MissingScope@yahoogroups.com. *— Rob Zimmerman, Public Observing Coordinator, Texas Astronomical Society, Dallas, Texas*

Memory Savor

I found "When Yuri Took Flight," by Jim Schefter (April 2001) the best *Astronomy* essay I have read since Gale Christiansen's biographical study of Edwin Hubble's brilliant career ("Mastering the Universe," February 1999). I especially enjoyed savoring the memory of both as I peered into the wondrous light of M104 from my balcony with my 8-inch SCT.

Additionally, I thought that same issue contained one of Bob Berman's best "Strange Universe" reports, "Vega — or Vanessa?" *— Brother Ignatios, Mount Athos, Greece*

Off Track

On page 78 of the "Happy Trails" article (July 2001), Eric DeBolt's "lone saguaro cactus over Mescal, Arizona" photograph caught my eye. Star trails must be parallel, but there is a trail in that shot next to the middle limb that is obviously not parallel. *— Gabriel Mandián, Montevideo, Uruguay*

Good eyes! That errant line of light was most likely the result of a meteor that appeared during the time exposure. — Rich Talcott, Astronomy *senior editor*

Calling Pluto's Moon

What is correct pronunciation for Pluto's moon, Charon? *— Rachelle Baker, Great Falls, Montana*

Charon is among the top three most mispronounced celestial objects. (The others are Uranus and Vega). In this case, pronounce the "ch" if it were a "k." So, while Uranus must be pronounced "You-rin-us," and Vega as "Vee-gah," think of Charon as just another spelling for anyone named Karen.

By the way, classical mythology associates Charon with Pluto (also known as Hades, the underground abode of the dead) because Charon's unenviable task was to ferry the dead across the River Styx to Hades. In other words, Charon's job was hell. — Bob Berman

---

Astronomy *invites reader responses. Send letters to* Astronomy *Talking Back, P.O. Box 1612, Waukesha, WI 53187; e-mail to talking@astronomy.com. Letters may be edited for space and clarity. Please include your city, state, and country with all correspondence. If you want to talk back to us, please visit our website, http://www.astronomy.com.*

Astronomy®

KALMBACH PUBLISHING CO.

PRESIDENT
Gerald B. Boettcher

VICE PRESIDENT, EDITORIAL, PUBLISHER
James J. Slocum

VICE PRESIDENT, MARKETING
Michael R. Stephens

VICE PRESIDENT, ADVERTISING
Scott Stollberg

CORPORATE ART DIRECTOR
Maureen M. Schimmel

MANAGING ART DIRECTOR
Lisa A. Zehner

PRODUCTION MANAGER
Annette Wall

CIRCULATION DIRECTOR
Jerry Burstein

CIRCULATION SPECIALIST
Kirsten King

ADVERTISING DEPARTMENT
(888) 558-1544

ADVERTISING SERVICES MANAGER
Sara Malin Everts severts@kalmbach.com

ADVERTISING SALES MANAGER
Howard Hoerl hhoerl@astronomy.com

ADVERTISING SALES REPRESENTATIVE
Michael Ellis mellis@astronomy.com

AD SERVICES REPRESENTATIVE
Joel Wingelman jwingelman@kalmbach.com

RETAIL TRADE ORDERS AND INQUIRIES:
(800) 558-1544, ext. 818; outside the U.S. and Canada: (262) 796-8776, ext. 818

SPECIAL E-MAIL ADDRESSES

Ask Astro askastro@astronomy.com

Hot Shots hotshots@astronomy.com

Star Stuff starstuff@astronomy.com

Talking Back talking@astronomy.com

Kids kids@astronomy.com

Customer Service customerservice@kalmbach.com

Ad Sales adsales@astronomy.com

Customer Service is Our Strength!

Aug 1-15 54th Anniversary Sale.
Helping our Customers since 1947.
Call for Anniversary Specials!

Proudly Featuring: SBIG, Losmandy, JMI, Kendrick, Coronado Instruments, Scopetronix, 1000 Oaks Optical, Lumicon, Starry Night Software

DISCOVERY TELESCOPES

Truss Designs

Combining Quality and Value with Large Aperture and Portability.

12.5" 15" 17.5"
starting at $1999

Meade LX200

FREE! $600
in Meade Super Plössl Eyepieces with the purchase of any LX200.
Exp. 8/15/01

Authorized Meade Dealer

CELESTRON

Nexstar 8
The universe is full of mysteries. Using a Nextstar isn't one of them.

$1499
Free Shipping
(except HI & AK)

Nagler
New 9, 7, 5 NaglerType6. Increased contrast and eye relief with reduced size and weight.

In Stock!

TeleVue® Visionary

OPT
OCEANSIDE PHOTO & TELESCOPE

800-338-9638

Open 7 days a week
Mon-Sat 10a-8p PDT
New! *Take advantage of our West Coast time zone. When you're out observing, we're just a phone call away. Our extended hours mean you can call us even late at night!*

www.optcorp.com

We're hard at work for you!
Visit our new, expanded website and watch our live action web cam.
You can order anything and everything you need online.
Visit often for new specials, discounts and clearance items.

The Astronomer's #1 Online Order Company

The best binoculars for discovering astronomy

Polaris 7x50 FMT-SX

Polaris 16x70 FMT-SX

Fujinon's flat-field POLARIS Series binoculars give you the world's brightest, high-resolution images. *Sky & Telescope* said the 7x50 Polaris was "incredible" and unlike the competition, had longer eye relief and a tripod adapter screw socket. POLARIS distortion-free optics increase the useful field area more than 40% by eliminating defocused star images near the field stop. You enjoy the widest, sharpest and brightest high-contrast views of globular clusters, galaxies and delicate nebulae detail. POLARIS 7x50, 10x70 and 16x70 binoculars are waterproof, meet US Mil Specs and are backed by Fujinon's lifetime limited warranty.

...and finding comets.

Hyakutake, among others, was discovered by Fujinon 25x150 and 40x150 binoculars. They're the largest, most powerful production binoculars in the world. Available with extra low dispersion ED glass, for outstanding color correction, they're also waterproof, built to mil specs and covered by Fujinon's limited lifetime warranty. For more information, contact:

FUJINON INC.
10 High Point Drive
Wayne, NJ 07470
(973) 633-5600 FAX (973) 694-8299

FUJINON

synctime metallic mesh band, metal bezel mineral lens, hi-tech polymer case $149.95

ATOMIC TIME
atomic radio with 2 alarms and tempature, day, date, LCD $39.95

NEW

Junghans atomic carbon, stainless bezel, sapphire lens LCD day date - carbon/leather band • $279.00

definitely atomic clock
definitely precise
definitely self setting

with the world's most accurate time pieces, atomic clocks & watches from

ATOMIC TIME ™

- watches for any time zone
- synchronized to the u.s. atomic clock in fort collins/co
- accurate to 1 second in 1 million years
- engineered in germany

complete line of atomic clocks
Junghans full ceramic or carbon fiber atomic watches in 12 styles, sapphire lens, bright lumi. hands for nighttime, waterresistant
Junghans solar watches
Junghans since 1861
over 100 different Atomic Time watches & clocks for home and office & weather stations

20% off second item

call for our free brochure:
or go to www.**atomictime.com**
credit card orders call toll free
1-800-985-8463
send checks/money orders for the total amount incl. s&h $6.95 to

ATOMIC TIME, INC.
1010 JORIE BLVD.
OAK BROOK, IL 60523

ATOMIC TIME
5:05 36
6:00 78
RADIO CONTROLLED
atomic dual alarm clock w. temperature day and date, black 3.5x4.5x2" $29.95

ATOMIC TIME
18:53
22.10
jumbo digit atomic clock w. temperature & day and date,wall or desk 8.5"x8.5"x1" • $49.95

black arabic 12" wall clock for home or office • $59.95 (wood $69.95)

2001 ADORAMA INC.

42 WEST 18th STREET • NEW YORK, NY 10011
ORDER TOLL FREE • US & CANADA
800-223-2500
800-723-6726

PRO OPTIC

Plössl 1.25" MULTI-COATED *Eyepieces*

• Sharp detail • High contrast ghost-free images • Wide 50° apparent field of view (43° on the 40mm Plössl) • 4 element optics • Lens edges are blackened to keep out reflected light • Accepts 1.25" filters.

40mm.....**34.95** 32mm .....**34.95** 25mm......**29.95**
20mm.......**24.95** 17mm .....**24.95** 12.5mm...**24.95**
10mm.......**24.95** 7.5mm ....**24.95** 6.3mm.....**24.95**

Short Tube Barlow Double the power of any eyepiece with this Barlow. Only 2¼" long. Works with all type of telescopes, including Refractors and Reflectors only **$29.95**

90MM SPOTTING SCOPE / TELEPHOTO KIT

Shown with optional Tripod
219.95

Kid includes 90mm optical tube, 25mm Plossl 1.25" eyepiece (20x) 45° Erect Image Diagonal & Deluxe Case

15-45x Fieldstar Spotting Scope Outfit Fully Coated, 2.25° f.o.v. at 15x, Long Eye Relief (33mm @ 15x) weighs only 25 oz, • Rubber Coated includes Case & Table Top Tripod **99.95**

New 15-45x Angle Spotting Scope Kit w/Case & Table Top Tripod 109.95

Slow Motion Control **$29.95**

ERECT IMAGE DIAGONAL

45° Erect 1.25" 29.95
45° Erect Hybrid (1.25" to .96") 34.95
90° Star Diagonal 1.25" 34.95
Straight Through Erector (Porro Prism)..........64.95

EYEPIECE FILTERS 1.25"

Available in the following colors: 1A Skylight; 8 Yellow; 11 Yellow Green; 12 Deep Yellow; 15 Deep Yellow; 21 Orange; 23A Red; 25 Red; 47 Violet; 56 Light Green; 58 Green; 80A Lt. Blue; 82A Pale Blue; ND 0.3; ND 0.6

1.25"@. ......**9.95** Moon Filter 1.25" (ND 9X)**11.95**
Buy any 4 filters (1.25")..........for only **34.95**
Buy any 12 filters ....for only **99.95**
4 Piece Filter Set with Pouch
Set #1 includes: #12, 23A, 58 & 80A Packaged in a Pouch **34.95**
Set #2 includes: #11, 25A, 47 & 82A **34.95**

BINOCULARS

These binoculars with their large objectives high quality BAK-4 prisms will provide you with breathtaking wide-field observation of astronomical objects as well as terrestrial viewing under low light conditions.

Each binocular is provided with a high quality Hard Case, Neck Straps and Rubber Eye-Cups.

Now includes 25 YEAR WARRANTY

70MM JUMBO
Fully Multi-Coated Series

11x70 Jumbo – 4° field of view, 21mm eye relief, weighs 2.8 lbs. **159.95**
16x70 Jumbo– 3.6° field of view, weighs 2.8 lbs. **169.95**

80MM GIANT
Fully Multi-Coated Series

11x80 Giant – 4.2° field of view, 14mm eye relief, weighs 5.25 lbs. **249.95**
20x80 Giant – 3.3° field of view, 14mm eye relief, weighs 5.25 lbs. **259.95**

100mm Ultra Giant Series

The ultra large aperture of 100mm provides more than 50% more light gathering power than the standard 80mm Giant Binoculars. For a delightful experience in astronomical viewing. Both feature multi-coated optics, BAK-4 prism, built-in platform which mounts on a tripod.

14x100 Ultra Giant .**$849.95** **25x100** Ultra Giant ...**$899.95**

Provides Stunning Views of The Night Sky
At A Price Far Below What Giant Binoculars Typically Cost ...BUDGET - PRICED...
As Written Up In Sky & Telescope June 2000

WWW.ADORAMA.COM

2001

ADORAMA

INC.

42 WEST 18th STREET • NEW YORK, NY 10011

9

PHONE ORDERS ACCEPTED DAY OR NIGHT
• Mon–Thurs. 9 till 9:30 PM
• Fri. 9-1:45
• Sunday 9:30–6 EST

STORE HOURS:
• Mon.–Thurs. 9–6:30pm
• Fri to 1:30 • SUN 9:30–5:30

web:
www.adorama.com

ORDER TOLL FREE • US & CANADA
800-223-2500
800-723-6726

ORDERS & INFO	FAX
212-647-9800	**212-675-8715**

CUSTOMER RELATIONS • 800-815-0702
• Mon–Thur. 9–4:30, EST
E-mail: info@adorama.com

CELESTRON®
SCHMIDT CASSEGRAIN

Celestar 8	1099.00
Hand Control f/Celestar	54.95
G-8 German Eq. 8"	999.95
G-5 w/Equatorial Mount	699.95

Celestron Nexstar

New Nexstar 4	599.95
Call About Special Package Deal	
Nexstar 8 W/Tripod	1699.95
New Nexstar 11	2999.95

New Reduced Prices

Nexstar 5 with tripod
1199.00

Celestron Reducer/Corrector f/6.3

114.95

Works with all Current Celestron and Meade Schmidt Cassegrains. Now it is possible to have a dual focal ratio instrument without sacrificing image quality. The Reducer/Corrector is f/6.3 for C8 and C11, f/7 for C14. A four element, fully multi-coated accessory. Results are amazing BOTH visually and photographically.

ACCESSORIES for NEXSTAR 5"

JMI

Motofocus	101.95	Celestron Case	149.95
Carry Case	129.95	Field Doubler For Nexstar 4	89.95
Celestron Tripod	174.95		

CELESTRON TELESCOPE ACCS.

AC Adpt. C5+, C8+ Ultima	18.95
Car Bat. Adpt. C5+,C8+ Ultima	19.95
2X Barlow 1.25" Short Tube	39.95
Counterweight Bar Assembly 8"	84.95
Case for C8/C5	179.95
Piggyback Mt 8"	34.95
Piggyback Bar Assembly 11"	69.95
New Folding Lens Shades	Call
MOTORS	
JMI DEC Motor C8+/Classic 8	84.95
JMI Motofocus f/Celestar 8, Nexstar 8	101.95
Celestron Focus Motor	109.95
Logic Drive f/CG3	39.95
S/A Drive w/Hand Cntrl f/CG-3	79.95
Single Axis Motor for CG-5	114.95
Dual Axis Drive for CG-4	159.95
Dual Axis Drive for CG-5	169.95
ADVANCED ASTRO MASTER	
Advanced Astro Master for C8 11, & G5 Mount	474.95
FILTERS	
LPR A	59.95
LPR B	84.95
Pol. Set 1¼"	44.95
Sky Filter #2	44.95
4 piece 1.25" FilterSet	49.95
DIAGONALS	
Diagonal Erect 1.25" 45°	39.95
Diagonal Erect 1.25" 90°	49.95
Star Diagonal 1.25" 90°	34.95
2" Mirror Star Diagonal	124.95
Celestron Stereo	
Binocluar Viewer	479.95

FINDERSCOPES	
9x50 Finderscope Kit	79.95
6x30 Finderscope Kit	34.95
7x50 Polaris Finder Scope with Illuminator & Bracket	159.95
Quick Release f/7x50 find	42.95
Star Pointer Finderscope	24.95
Polar Axis Finder f/CG-4/5	44.95
1.25" RACK & PINION FOCUSERS	
1.25" Focuser	29.95
GUIDING SYSTEM	
Radial Guider	84.95
Micro Guide Eyepiece	139.95
10mm Plossl Reticle	84.95
20mm Cross Hair Eyepce	34.95
Standard Illuminator	39.95
TRIPODS & MOUNTS	
Adj. Tripod Heavy Duty	264.95
CG-3 Equatorial Mnt	149.95
CG-5 Equatorial Mnt	359.95
Vibration Suppression Pads	39.95
NIGHT VISION ASTROLIGHTS	
Night Vision LED Light	14.95
T-ADAPTER/TELE EXTENDERS	
Tele Extender Deluxe	48.95
T-Adapt. f/Schmidt Cassegrains	24.95
T-Adapter/Barlow Lens 1.25"	39.95
T-C 16mm Adapter	29.95

ULTIMA EYEPIECES

5mm, 1¼"	67.95	7.5, 1¼"	67.95	12.5mm, 1¼"	67.95
18mm 1¼"	67.95	30mm, 1¼"	84.95	42m, 1¼"	89.95
35m 1¼"	96.95	2X Ultima Barlow Lens			62.95

PLOSSL EYEPIECES

7.5, 17mm, 1¼"	31.95

NEXSTAR PLOSSL EYEPIECES 1.25"

3.6,6,8,10,13,17,25mm	39.95	32, 40mm,	49.95

AXIOM EYEPIECES

15mm 1¼"	129.95	19mm 1¼"	139.95	23mm, 1¼"	149.95
19mm 2"	169.95	34mm 2"	209.95	40mm, 2"	249.95
50mm 2"	274.95				

NEXSTAR REFRACTORS

Nexstar 60-GT	249.95
Nexstar 70	349.95
Nexstar 80-HC	199.95
Nexstar 80-GT	349.95
Nexstar 60/80 Soft Case	79.00
Nexstar 80/114 Hard Case (for Scope only)	99.00

NEXSTAR REFLECTORS

Nexstar 114 HC	209.95	Nexstar 114 GT	439.95
New Nextar 130mm Reflector			599.00

REFRACTORS		REFLECTORS	
		8" Reflector	699.95
C80 Heavy Duty	299.95	**C-150** H.D. 6"	449.95
Firstscope 80 EQ.	219.95		

SPOTTING SCOPES

80mm Wide Field with 2		New 102mm Wide	Call
Plossl Eyepieces	Call	15-60X Zoom	144.95

SKYGAZER

90mm Equatorial Refractor Telescope with Three 1.25" Eyepieces

90mm diameter Refractor with German Equatorial Mount, Slow Motion Controls in R.A. and DEC., 6x30 Viewfinder, Three 1.25" 25mm (36X) & 12.5mm (72x) and 6.3mm (142x) Eyepieces, aluminum Tripod with Accessory Tray

$199.95

BINOCULARS/SPOTTING SCOPE

FUJINON FMT-SX Binoculars

FUJI REBATE
$80. *Cash in 14x40*
$30. *Cash in 7x50 FMTR/FMTRC*

14x40 Techno Stabi	Call
7x50 FMT-SX	Call
7x50 FMTR-SX	Call
7x50 FMTR-CSX R.C. w/Compass	Call
8x30 FMTR-SX R.C.	Call
10x70 FMT-SX w/Case	Call
16x70 FMT-SX w/Case	Call
8x42 BFL	Call
10x42 BFL	Call

CD Waterproof

7x42	Call	8x42	Call
10x42	Call		

CANON

Image Stabilized

10x30	Call	12x36	Call
15x50	Call	18x50	Call

KOWA 82mm

w/20 to 60x Zoom			
TSN-821B	Call.	TSN-822	Call
TSN-823	Call	TSN-824B	Call.
W/O Eye Piece			
TSN-821B	Call	TSN-822	Call.
TSN-823	Call.	TSN-824B	Call..
27x L.E.R.	Call	32x w.a.	194.95.
20-60x Zoom Eyepiece			274.95
PA2-C 82mm Photo Adapt.			174.95
20-60x f/60mm			139.95

Fieldscope Super 80

Super 80 with 20X-60X	Call
Super 80 ED with 20X-60X	Call

CELESTRON

GIANT MULTI-COATED			
20x80 Deluxe	Call		
REGAL			
8x42	Call	10x50	Call
NEW NOBAL			
8x32	Call	8x42.	Call
10x42	Call	10x50	Call
ULTIMA SERIES			
7x50	Call	8x40.	Call
10x50	Call	8x56	Call
9x63	Call		
MINI M/C with Case			
8x21	36.95		
10x25	46.95	7-16x25	64.95
MONOCULAR– 8x25	34.95		

BUSHNELL

ELITE Waterproof

15-45 60mm w/Case	Call
20-60x 70mm w/Case	399.95
20-60x 80mm w/Case	Call

STAR ATLASES

Sky Atlas 2000 Field Ed.	29.95	Laminated Sky Atlas 2000 Field Edition	64.95
Celestron Sky Map	16.95	Celestron Sky Map	16.95
Sky Atlas 2000 Deluxe	44.95	Atlas of Deep Sky Splendors 4th Edition	24.95

DIGTIAL ASTRO PHOTOGRAPHY

DIGI-T DIGITAL CAMERA ADAPTER

Fits onto most 1.25" eyepieces and allows you to attach it to a Digital Camera

DIGI-T Camera Adapter Kit F/**Nikon CoolPix's**	59.95
DIGI-T Camera Adapter Kit F/**Nikon CoolPix 880**	89.95
DIGI-T Camera Adapter Kit F/**Olympus 2/3000**	89.95

Also available for many other cameras call f/details

DIGITAL CAMERA ADAPTERS

allows you to connect your camera direct to a telescope (requires a T-Adapter)

Digital Camera Adapter TO FIT Cameras with 28/37mm/49mmmm filterthreads	24.95

Night Navigator *$79.95*

The Electronic Star Locator

Locates and Identifies Constellations Quickly.

- Scientific patented computer tracking system to accurately locate and identify constellations, planets, and stars quickly and effortlessly.
- Innovative built-in digital electronic compass automatically plots your location.
- Motorized map delivery system for easy sky navigation.

ASTRONOMY SOFTWARE

THE SKY for Windows 95

Sky Level 2 or 3	Call
Sky GSC (CD ROM) Level 4	Call

We Now Carry The *STARRY NIGHT PRODUCTS*

VIXEN LANTHANUM
Eyepieces LV Series

2.5mm,	99.95	4mm	94.95	5mm	89.95
6mm	89.95				
9mm	89.95				
10mm	89.95				
12mm	99.95				
15mm	89.95				

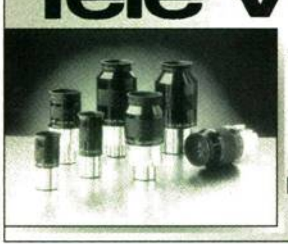
LV Zoom

8-24mm Zoom	149.95

PENTAX XL SMC Eyepieces

5.2, 7, 10.5, 14, 21, 28mm, 1.25"	219.95
40mm, 2"	234.95

Tele Vue®



WE STOCK THE COMPLETE LINE

TELE VUE REFRACTORS

PRONTO

70mm Aperture f/6.4 with ED Glass	925.00
101mm and 85mm REFRACTORS	
101mm	2760.00
85mm	1995.00

BUSHNELL

60mm Zoom Voyager Refractor	79.95

Bushnell Compact 4.5" Reflector

$129.95

Features a unique cradle mount which is convenient to use and transport. A wide field of view makes it easy to locate objects and keep them in view
- Aperture: 4.5" • Focal Length: 400mm
- Eyepieces: 1.25" 4mm (100X), and 25mm (16x)
- Focuser: Precision Rack & Pinion,

Tripod adaptable, includes convenient shoulder strap

TELESCOPE ACCESSORIES

DEW SHIELD

Collapsible, fold down, easy to store and transport

for Celestron C90	18.95	f/10" Schmidt Cassegrains	38.95
f/8" Schmidt Cassegrains	28.95	f/11" Scopes	49.95
f/5" Scopes	24.95		

LUMICON FILTERS

BUY ANY 2 FILTERS AND TAKE 7% OFF THESE PRICES
UHC Premium, Deep Sky Premium, H-Beta or Oxygen III

1¼"	99.50	48mm	199.95	2" T Mount	199.95

TELRAD FINDER

TELRAD with Base	36.95	Spare Mounting Base	7.95
Dew Shield for Telrad	11.95		

EASY TESTER

Optical Evaluation Eyepiece	29.95

JMI FOCUSERS

NGF-DX1	233.00	NGF-S w/Motofocus	242.00
NGF-DX2	180.00	NGF-DX3	144.00

SOLAR FILTERS GLASS

for Celestron C90/G3 & Meade ETX-90	59.95
for Tele Vue 101/102	59.95
for Tele Vue Pronto/Ranger Televue	49.95
for Celestron Nexstar 5" & Meade ETX-125	64.95
for Schmidt Cassegrains 8"	79.95
for Meade 10"	99.95

WE SHIP PROMPTLY. ALL TELESCOPES INCLUDE U.S.A. WARRANTY
No Surcharge for MasterCharge or Visa Purchases. Personal checks welcome, will ship without delay. Name must be imprinted on check, also include address, phone, and a copy of major credit card or driver's license for reference. Shipping, handling and insurance additional. 14 day money back guarantee less shipping, with packing and blank warranty card, except film and paper. We ship UPS. Some items special order. All orders are subject to acceptance and verification. Second hand dealer's license #802862. Pictures are for illustration purposes only and may not be exact. Wa are not authorized Meade dealers.
Prices effective till Sept. 10, 01 **Please address all inquiries and orders to ASTRO. DEPT. #55**

Your Credit Card Will Only Be Charged At Time Of Shipping For Items Actually Shipped

The Biggest Thing To Hit Astronomy Since The Bang.

NexStar 8" gps
{ $2,499^00 }
INTRODUCTORY PRICE
Freight charges may apply

GPS
GLOBAL POSITIONING SYSTEM

Introducing The New NexStar® 8" GPS.

Spend less time setting up and more time stargazing with the most technologically advanced telescopes on the planet, Celestron's new **NexStar 8" GPS** and **NexStar 11" GPS.** ● As the first commercial telescopes to feature Global Positioning Systems, these advanced NexStars can have you navigating the night sky like a pro no matter how knowledgeable you are. Just turn on your telescope and the NexStar's GPS will pinpoint your coordinates, the time and the date, the integrated electronic compass will find north and level the telescope, and the vast GOTO database will seek out whatever it is you want to see. It's actually that simple. ● If you would like to learn more about these sophisticated sky scopes, call 310-328-9560. Or visit the Celestron retailer nearest you.

NexStar 11" gps
{ $2,999^00 }
SUGGESTED RETAIL PRICE THROUGH SEPTEMBER 2001
Freight charges may apply

CELESTRON

FEATURES & SPECIFICATIONS

SOFTWARE:
- 40,000+ object database. Stores numerous user-defined objects.

ELECTRONICS:
- Computerized hand control with easy-to-read backlit liquid crystal display (LCD) unit
- Permanent Periodic Error Correction (PPEC) – once periodic errors are recorded for elimination, the telescope maintains the recording even when turned off and on
- Built-in, adjustable backlash compensation
- AutoGuider Port
- Port for 12V DC power output
- Fastar compatible for f/2 CCD Imaging

- RS-232 ports for communication with a PC to operate and use with the telescope (one on hand control and one on base drive)
- Dual ports for serial communication with future smart accessories

MECHANICAL
- Dual die-cast aluminum fork tines
- Large 9.5" roller bearing track for an ultra-stable polar axis
- 5.625", 180-tooth gears with precision worms for accurate tracking
- Hand control rests in its built-in home within the fork tine for easy usage
- Internal Slip Ring design provides power to telescope while preventing cord wrap

DAMPING TIME
- Less than one second

OPTICS
- NexStar 8 GPS 8" (203.2mm) large aperture Schmidt-Cassegrain optical system
- Focal length of 2032mm at f/10
- Resolution: .57 arc seconds
- NexStar 11 GPS 11" (279mm) large aperture Schmidt-Cassegrain optical system
- Focal length of 2800mm at f/10
- Resolution: .41 arc seconds

WEIGHT
- NexStar 8 GPS only 42 pounds
- NexStar 11 GPS only 65 pounds
- Tripod weighs only 26 pounds

standard accessories

nexstar 8 gps	nexstar 11 gps
40mm multi-coated 1.25" Plössl eyepiece (51X)	40mm multi-coated 1.25" Plössl eyepiece (70x)
9x50 Finderscope	9x50 Finderscope
AC adapter	AC adapter
Carbon Fiber Tube	Carbon Fiber Tube
1.25" star diagonal	1.25" star diagonal
Heavy duty tripod	Heavy duty tripod

optional accessories
- Equatorial Heavy Duty Wedge
- Reducer/Corrector F/6.3
- Solar Filter
- Car Battery Adapter
- Eyepiece Filters
- Photo Adapters
- 12-volt battery supply

Find out more about our other exceptional telescopes and optical gear, and nearby dealers. (310) 328-9560 • www.celestron.com

3,426 Stars. 618 Celestial Phenomena. 28 Moons and Planets. One Button.

Celestron's NexStar® telescopes are so simple to operate, practically anyone can be set up and stargazing within minutes of taking one out of the box. That's because each comes with a pre-programmed database containing the coordinates for thousands of spectacular celestial sights. ● Thanks to this incredible GOTO technology, all you have to know is where you are, what time it is, and the date. Then choose what you want to see and the NexStar seeks it out. ● With a wide variety of powers and price points, plus the smart engineering and precise optics you can only get from Celestron, you're sure to find a NexStar that's just right for you.

CELESTRON®

Find out more about our other exceptional telescopes and optical gear, and nearby dealers.
(310) 328-9560 • www.celestron.com

©2001 Celestron International

NEXSTAR 60GT

$249.00
Suggested retail price

- 60mm (2.4") diameter
- 700mm focal length (f/12)
- StarPointer™ finderscope
- 20mm (35x), 10mm (70x), and 4mm (175x) MA eyepieces
- 1.25" star diagonal
- Hand control with 4,000 object database
- Includes sturdy metal tripod

NEXSTAR 80GT

$349.00
Suggested retail price

- 80mm (3.1") diameter
- 400mm focal length (f/5)
- StarPointer™ finderscope
- 25mm (16x), 10mm (40x) eyepieces
- 1.25" star diagonal
- Hand control with 4,000 object database
- Includes sturdy metal tripod

NEXSTAR 114GT

$439.00
Suggested retail price

- 114mm (4.5") diameter
- 1000mm focal length (f/9)
- StarPointer™ finderscope
- 25mm (40x), 10mm (100x) SMA eyepieces
- 1.25" star diagonal
- Hand control with 4,000 object database
- Includes sturdy metal tripod

NEXSTAR 4

$599.00
Suggested retail price

- 4" Maksutov-Cassegrain optics
- 1,325mm focal length (f/13)
- StarPointer™ finderscope
- 25mm (53x) SMA eyepiece
- Hand control with 4,000 object database
- 1.25" star diagonal with flip mirror system
- Optional tripod available

NEXSTAR 5

$1149.00
Suggested retail price

- 5" Schmidt-Cassegrain optics
- 1,250mm focal length (f/10)
- StarBright™ multicoatings
- StarPointer™ finderscope
- 25mm (50x) Plössl eyepiece
- 1.25" star diagonal
- Hand control with 18,000 object database
- Includes tripod and AC adapter

NEXSTAR 8

$1499.00
Suggested retail price

- 8" Schmidt-Cassegrain optics
- 2,032mm focal length (f/10)
- StarBright™ multicoatings
- StarPointer™ finderscope
- 40mm (51x) Plössl eyepiece
- 1.25" star diagonal
- Hand control with 18,000 object database
- Includes tripod and AC adapter

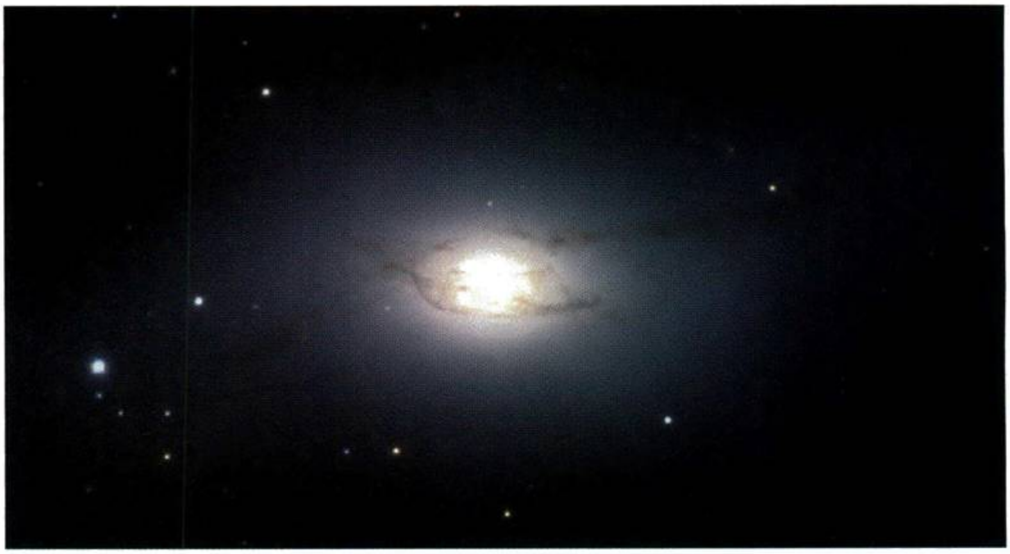
NEW SURVEY RESULTS

Science Flows from Sloan Survey

▶ On target to map one-fourth of the entire sky in unprecedented digital detail within five years, the Sloan Digital Sky Survey promises an incredible stream of important discoveries. Several recent results — on distant quasars, the distribution of galaxies, and the segregation of asteroids — just hint at what should be in store. Astronomers announced the latest findings at the June 2001 meeting of the American Astronomical Society in Pasadena, California.

On the quasar front, the Sloan Survey discovered the two most distant objects ever seen. With redshifts of 6.0 and 6.2, meaning the expansion of the universe has shifted their light to longer wavelengths by 600 and 620 percent, respectively, the quasars easily beat out the former record holder. That quasar, also discovered by the Sloan Survey, had a redshift of 5.8.

Quasars, the highly luminous centers of distant galaxies that are powered by accretion onto a supermassive black hole, can be seen across the universe. Sloan is particularly adept at spotting quasars because it observes in five different colors, allowing scientists to differentiate between the quasars and the ubiquitous faint stars in our own galaxy. The survey's goal is to observe 100,000 quasars. The current tally stands at more than 13,000 and includes the four most distant objects yet seen and 26 of the 30 most distant quasars.



Sloan Digital Sky Survey

Networks of dust veins crisscross this Sloan image of Virgo Cluster galaxy NGC 4753, 50 million light-years away.

Early findings regarding the distribution of galaxies reinforce the idea that we live in a low-density universe whose rate of expansion is accelerating. In conjunction with recent studies of the cosmic microwave background radiation, the galaxy distribution also supports the inflationary model of the early universe. "Our observations are consistent with the idea that our universe underwent a burst of enormous expansion when it was a fraction of a second old," says Josh Frieman of the University of Chicago and the Fermi National Accelerator Laboratory.

Not all of the Sloan Survey concentrates on the distant universe. Asteroids in our solar system often show up on the digital images, and astronomers get the same detailed color information on them. The most surprising finding so far is that the two main types of asteroids seem to lie at different distances from the sun.

Rocky silicate asteroids orbit at an average distance of 2.8 astronomical units (or AU, where 1 AU is the distance of Earth from the sun), while the more primitive carbonaceous asteroids lie in an outer belt centered at a distance of about 3.2 AU.

A further surprise turned up when the Sky Survey found fewer asteroids smaller than about 2.5 miles (4 km) in diameter. Astronomers had expected the number of objects to keep increasing as the objects' size decreased. "Since the asteroid belt is believed to be the reservoir for Earth-crossing asteroids," says Zeljko Ivezic of Princeton University, "the new observations suggest that future asteroid collisions with Earth may be less likely than previously believed." — RICHARD TALCOTT

GLOBULAR CLUSTERS

A Square Dance in Space

▶ In a spectacular collaboration between scientists using the Hubble Space Telescope and the Chandra X-ray Observatory, astronomers have resolved the central blur of the giant globular cluster 47 Tucanae. The observations produced the first census of the cluster's x-ray population, revealing dozens of pulsars and strange binary systems packed into a region just a few light-years across.

Located about 15,000 light-years from Earth, 47 Tucanae recently posed for a Hubble portrait.

The Universe Is Expanding. Shouldn't Your Telescope?

You've spent untold hours deep-sky gazing through your telescope. Maybe now is the perfect time to enhance the experience with finely crafted accessories from Celestron®. Each item in our entire line fits any leading brand of telescope, so no matter how you were introduced to stargazing, Celestron can make it more enjoyable. With a wide variety of eyepieces, filters, field accessories, and astrophotography equipment, you'll find exactly what you need with the smart engineering and precise optics you can get only from Celestron. ● To learn more about our full line of accessories, call 310-328-9560 today. Or visit a Celestron retailer near you.

CELESTRON
ALL THE RIGHT GEAR FOR THE PERFECT VIEW

>>> Look for the distinctive Celestron Accessory packages at your favorite retail store.

>>> GEAR UP FOR YOUR JOURNEY WITH CELESTRON ACCESSORIES.

Ultima® Eyepieces

NexStar® Plössl Eyepieces

Axiom® Eyepieces

Eyepiece Filter Sets

Moon Filter

Light Pollution Reduction Filter

T-Rings

Radial Guider

T-Adapters

Red Flashlight

Car Battery Adapter

AC Adapter

Hard Telescope Case

Soft Telescope Case

Steel Tripod/Wedge

CELESTRON®

Find out more about our exceptional telescopes, other optical gear, and nearby dealers.
(310) 328-9560 • www.celestron.com

©2001 Celestron International

Astronomers expected to find evidence of more than a dozen Jupiter-sized planets lurking in the cluster. Instead they found none. (See "No Planets in Globular Cluster," AstroNews, February 2001.)

The Chandra observations, however, have produced an additional surprise. When a team of astronomers led by Jonathan Grindlay of the Harvard-Smithsonian Center for Astrophysics aimed Chandra at the globular cluster's core, they found its central light-year swarming with at least 108 x-ray objects, far more than expected. "This Chandra image provides the first complete census of compact binaries in the core of a globular cluster," says Grindlay.

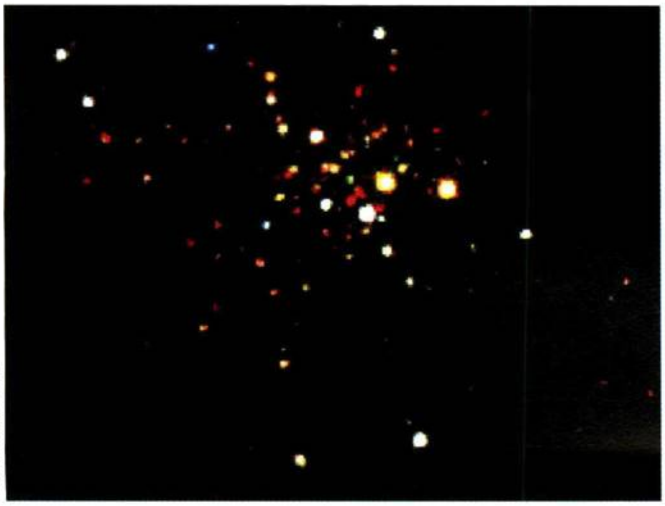
More than half of these objects appear to be solitary millisecond pulsars — rotating hundreds of times per second. Yet only a handful of the rest of the population seem to be x-ray binaries containing at least one neutron star. According to theory, these x-ray binaries evolve into millisecond pulsars, which means the numbers of both types should be about the same. Why Chandra is uncovering such a population discrepancy in 47 Tucanae remains to be explained.

The census of x-ray objects revealed further surprises. The numerous binary systems include many different combinations, including neutron stars paired with white dwarfs, neutron stars paired with main-sequence stars, and white dwarfs paired with main-sequence stars.

In too many cases, however, the astronomers found these binary combinations to be unlikely or unexpected. Often the ages of the two stars don't correspond. And many times the main-sequence partner is either too small or in too wide an orbit to have lost matter onto its white dwarf or neutron star companion, the typical way such a system becomes bright in x rays.

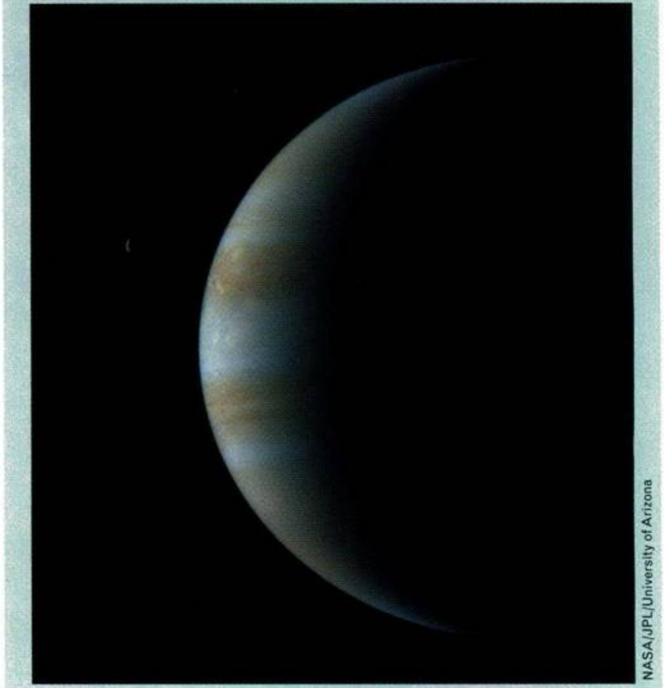
To create such mismatches, Grindlay tentatively believes that the binary systems — traveling in the incredibly packed regions at the cluster's center — might very well have been trading partners with each other, "like dancers at a square dance," he says. — Robert Zimmerman

Surprises abound in the x-ray core of globular cluster 47 Tucanae.



NASA/CfA/J. Grindlay

CASSINI AT JUPITER



NASA/JPL/University of Arizona

JUPITER BIDS A FOND FAREWELL to Cassini, as the spacecraft heads farther out into the solar system. This view shows Jupiter as a looming crescent, a phase that can never be seen from Earth. Taken from a distance of 11.4 million miles (18.3 million km) on January 15, 2001 — two weeks after its closest approach to the planet — the image shows features as small as 70 miles (110 km) across. A close look to the left of the jovian crescent reveals a ruddy object with a similar shape: the volcanically active moon Io. Cassini turned off its camera on March 22 and is now on the final leg of its journey toward Saturn, where it will enter into orbit on July 1, 2004.

COSMOLOGY

Cosmic Models Match Reality

▶ Despite occasional harsh criticism that their work amounts to little more than "Nintendo" astronomy, astronomical modelers have long insisted that they're not simply playing games when it comes to simulating the universe and its evolution. Finally, new observational data from one of the world's largest ground-based telescopes confirms that these terabyte theorists have been on the right track all along.

An international team of astronomers led by Palle Moeller of the European Southern Observatory (ESO) in Garching, Germany, recently announced the results of their study of objects near the distant quasar Q1205–30. With ESO's 8.2-meter (27-foot)

Meteor*Storm*Coming!

Exclusive expedition to greatest predictable spectacle in the skies: peak~10,000 meteors/hour! Guam Island, astronomy/history/culture/sun&surf: 2001 Nov. 14-20, $250-$3000 pp.

*"Of all the wonders of the skies, this meteor storm is the one **I most want to see!**"* -- Lead Astronomer Tom Van Flandern

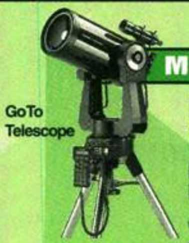
Eclipse Edge Expeditions
P.O. Box 15186
Chevy Chase, MD 20825

800/898-3343 recording
202/362-9176 voice
<http://eclipseedge.org>

FOR THE LOWEST PRICES & BEST SERVICES TO ORDER CALL TOLL FREE
Phone Orders: Mon through Sat. 9-6 Pacific Standard Times
fax: 818-992-4486

WOODLAND HILLS Camera & Telescopes

5348 Topanga Canyon Blvd.
Woodland Hills, CA 91364
telephone: 818-347-2270
fax: 818-992-4486



MEADE

Meade 7", 8", 10" & 12"
Dobs, Newtonian, SCT's & Refractors in stock.

We have the complete line of **Meade** CCD cameras in stock.

FULL LINE MEADE STOCKING DEALER!

FOR GREAT DEALS GAZE AT OUR WEBSITE
WWW.TELESCOPES.NET

Last Call for Astrophotographer's Dream

Celestron 8 Telescope Deluxe
with P.E.C., 9x50 finder, faster & compatible, wedge & tripod **$1399.00**

ON SPECIAL!
Meade Maksutov 90
Trade in your old Maksutov for a new one.

Firstscope 80 EQ **$159**
80mm (3.1") diameter refractor, 900mm focal length (f/11)

Meade 114mm Telescopes Includes Motors
$179

CALL US FOR MEADE FREE TRIPOD SPECIAL

FREE SHIPPING! (WITHIN THE 48 STATES)

CELESTRON

NexStar 8

Includes Dew Sheild	**$1499**
Ultima 2000	**$1998**

CELESTRON 1 1/4" EYEPIECES

ULTIMA EYEPIECES

5mm, 1 1/4"	$67.95	7.5	$67.95
12.5mm, 1 1/4"	$67.95	18mm, 24mm, 1 1/4"	$77.95
30mm, 1 1/4"	$84.95	35mm, 1 1/4"	$99.95
42mm 1 1/4"	$99.95		

Ultima Barlow Short Tube Version	$67.95

PLOSSL EYEPIECES

3.6, 6.3, 7.5,13, 10, 17, 1 1/4"	$36.95
32, 40mm, 1 1/4"	$59.00

TELEVUE 102 IN-STOCK

Plossl-50°

8-11, or 15	$82
20 or 25mm	$95

Panoptic-68°

15mm	$210
19mm	$240

Nagler-82°

4.8mm	$175
7mm	$220
Nagler type 4 12mm	$340
Nagler type 5 31mm	NOW IN STOCK!

Celestron C90 Rubber Armored 1 1/4" Eyepiece **$349**
FREE EXTRA EYEPIECE!

The New NexStar 11 GoTo Telescopes by Celestron - In stock

CALL

1-888-4ASTRONOMY
(1-888-427-8766)

ENCHANTED SKIES STAR PARTY
October 18-21, 2001

- Dark, dark skies
- Great chuck-wagon food
- Outstanding speakers
- Amateur poster session
- Vendor displays

For full details, see:
www.socorro-nm.com
click on "events"

or contact:
Chamber of Commerce
P.O. Box 743-A
Socorro, NM 87801
(505) 835-0424
chamber@socorro-nm.com

NEW MEXICO LAND OF ENCHANTMENT

Socorro, New Mexico
80 mi. South of Albuquerque

REACH OUT AND EXPLORE THE NIGHT SKY WITH OUR FAMOUS, AWARD WINNING

ASTROSCAN® WIDE-FIELD 2001 TELESCOPE

The ideal first telescope for your family!
- Award-Winning Compact Design
- Spectacular Extra Wide 3° Field

Astroscan® 2001 Telescope
- Padded Table-Top Base
- Open Sight Target Finder
- 28mm RKE® Eyepiece
- Dust Cap and Carry Strap
- 36 Page Users Manual
- 40 Page "Sky Guide"
- 5 ES Year Limited Warranty

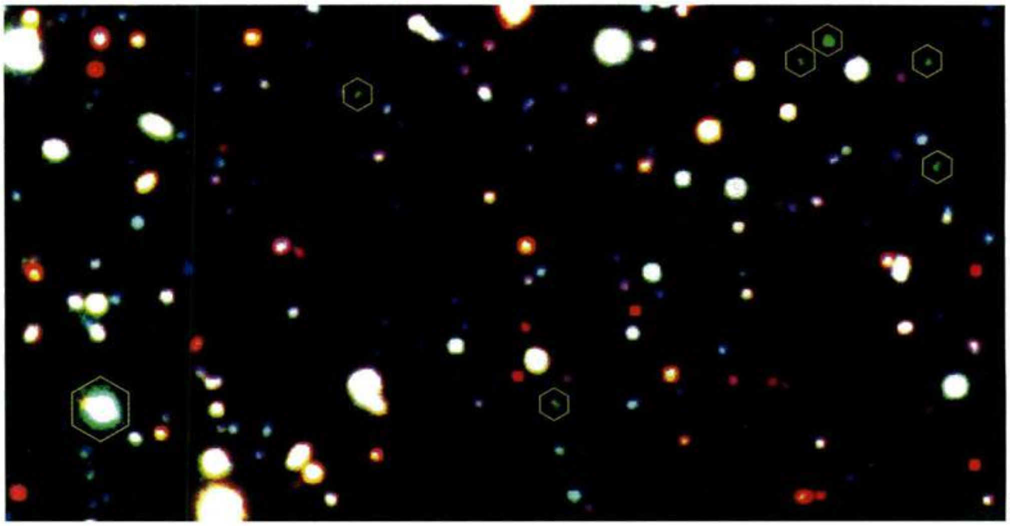
Reg. $349
SAVE $50
now only
$299
#AP30020-01

30 DAY MONEY BACK GUARANTEE!

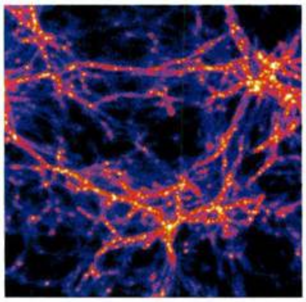
Order online or call toll free
800-728-6999 for FREE CATALOG
www.scientificsonline.com

EDMUND SCIENTIFIC'S
SCIENTIFICS®

Dept. D019-C821, 60 Pearce Ave., Tonawanda, NY 14150
Fax: 716-874-9572 • E-mail: cons_order@edsci.com



ESO



ESO

Above: Vivid-green protogalaxies crowd the quasar Q1205–30 (larger object at lower left). Left: Mirroring this computer simulation, research shows that the objects lie along a filament only 13 million light-years thick.

Antu telescope — part of the Very Large Telescope (VLT) array at Paranal Observatory in Chile — Moeller's team was able to create a three-dimensional map of Q1205–30's celestial neighborhood.

Their results indicate that surrounding objects, including eight proto-galactic objects, are situated along a narrow filament, just as theoretical simulations predict. What's more, the discovery of this filamentary structure near Q1205–30 underscores the cosmological power that the new breed of 8-meter to 10-meter class telescopes, like the VLT, possesses.

Thanks to the fast data handling and ample storage capacity of modern supercomputers, theorists are able to track the entire evolution of the universe to its present epoch in just a matter of hours. And although different formation models target different cosmological parameters and phenomena, they all predict that cosmic filaments, much like a spider's web or the complex neural structure of the human brain, were the first things to form. According to supercomputer simulations, galaxies, clusters, and superclusters later formed at the intersections and nodes of these cosmic filaments. Yet until now, astronomers have been unable to either confirm or deny the validity of these claims.

"We have little doubt that for the first time, we are seeing a small cosmic filament in the early universe," says Moeller. "At this enormous distance, we see the filament at a time when the universe was only about 2 billion years old."

The team, which also included ESO astronomer Johan Fynbo and Danish Institute of Physics and Astronomy researcher Bjarne Thomsen, uncovered the structure of the distant filament, some 13 billion light-years away, by looking for signatures of infant objects that emit specific wavelengths of ultraviolet light.

As stars form out of compact hydrogen clouds, these host clouds absorb ultraviolet light from the stars and re-emit it at a single wavelength. This radiation, called Lyman-alpha emission, occurs at a wavelength of 121.6 nanometers and is largely invisible to earthbound telescopes because the atmosphere absorbs ultraviolet light.

But if Lyman-alpha emitting systems lie very far away, the expansion of the universe will shift their ultraviolet light to visible wavelengths. Moeller's team calls these remote systems Lyman-alpha Emitting Galaxy-building Objects, or LEGOs. The team used a series of special filters to search the sky around Q1205–30 for LEGOs. Because the researchers knew Q1205–30 has a redshift of 3.04 (meaning that the expansion of the universe has shifted the light from its original wavelength by a little more than 300 percent), they expected the ultraviolet light from neighboring LEGOs to be shifted from 121.6 nanometers to 490 nanometers (in the green portion of the visible spectrum). The LEGOs of interest — the team found eight — stand out as intensely green objects.

Once Moeller's team was able to obtain spectra for each LEGO, they could determine each object's distance and construct a three-dimensional map. — William Schomaker

INSTRUMENTATION

Listening for Meteors

▶ Imagine a scientist who spends his days hoping that he won't find anything at all. Believe it or not, Los Alamos National Laboratory researchers Rod Whitaker, Doug ReVelle, and Peter Brown do just that. Well … almost.

A Leonid fireball pierced the sky over Monteromano, Italy, in 1998.

Lorenzo Lovato

LUMICON®

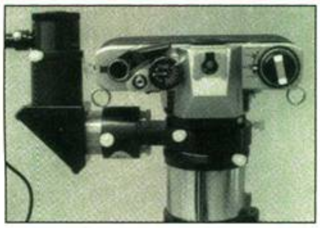
VISIT OUR SECURE WEB SITE
@ WWW.LUMICON.COM

6242 Preston Avenue
Livermore CA 94550
Phone hours: M-F 9AM/7PM pst
Sat. 9AM/3PM pst 1-925-447-9570

21 Years of Innovation!

ORDER TOLL FREE
1-800-767-9576

For Astrophotographers



Newtonian Easy-Guider ™

The **LUMICON NEWTONIAN EASY-GUIDER ™** is the best choice on the market for guiding both Newtonian and Refractor telescopes. Off-axis guiding is the surest way to get pin-point star images. The two-way adjustment on the off-axis tube avoids the problems of finding and centering a guide star in your eyepiece or autoguider. A 35mm camera adapter is included (specify camera). Available for either 1.25" or 2" focusers at .... **$189.50 each**

Cassegrain Easy Guider™

For 8" Schmidt-Cassegrain telescopes choose the **LUMICON CASSEGRAIN EASY GUIDER™.** Includes multiple adjustments for easily finding and centering a guide star and for composing the picture. The included internal 50mm focal reducing lens delivers brighter f/6 photographic images and can be used visually with an optional adapter. The lens can be removed for f/10 photography. A 35mm camera adapter (specify camera) is included **$249**

Visual Adapter **$25**

Lumicon Giant Easy Guider™

The king of off axis guiders is the **LUMICON GIANT EASY GUIDER™.** Made for Schmidt-Cassegrain telescopes of 10" through 16" diameter, the giant easy guider attaches to the large 3" rear threads of these scopes. Included is an 80mm diameter focal reducing lens capable of delivering f/7 to f/4 photographic speed. Replacing the included 35mm camera adapter (specify camera) with a 2" star diagonal turns the giant easy guider into a full aperture rich-field viewer **$395**

1 1/4" viewing adapter for rich-field ... **$25**

LUMICON FILTERS - BEST FOR PHOTOS AND VISUAL OBSERVING

MICON H-BETA
ICON OIII
MICON UHC
ON DEEP-SKY

Lumicon Deep Sky Filters block light polluting mercury and sodium vapor lamp emissions while letting thru all other parts of the spectrum. Deep Sky Filters are most useful for astrophotography (both color & b&w plus CCD work. However, Deep Sky Filters are also useful visually, offering contrast gain for nebula, galaxies, star clusters and dusty comets.

1.25" Deep Sky Filter (fits most 1.25" eyepieces)	$99.50
48mm Deep Sky Filter (fits 2" eyepieces and Lumicon accessories)	$199.50
Visual Back Deep Sky Filter (fits in series on back threads of SCT'S)	$199.50
2" Deep Sky Filter (fits 2" eyepieces and T-threaded accessories)	$199.50
72mm Deep Sky Filter (for the front of large telephoto lenses*)	$399.50

*step rings for other sizes available.

Lumicon Ultra High Contrast Filters provide high-contrast views of all types of nebula. Best used with any telescope of f/6 or longer focal ratio. The Ultra High Contrast Filter is not for photography.

1.25" Ultra High Contrast Filter (fits most 1.25" eyepieces)	$99.50
48mm Ultra High Contrast Filter (fits 2" eyepieces and Lumicon accessories)	$199.50
Visual Back Ultra High Contrast Filter (fits in series on back threads of SCT'S)	$199.50

Lumicon Oxygen III Get maximum contrast gain possible on planetary nebula and most emission nebula. Views of the Veil Nebula, the "Swan" the "Lagoon" and others with this filter are beyond words. The Lumicon Oxygen III Filter is for visual use only and is best suited for 6" and larger aperture telescopes with focal ratio of f/10 or faster.

1.25" Oxygen III Filter (fits most 1.25" eyepieces)	$99.50
48mm Oxygen III Filter (fits 2" eyepieces and Lumicon accessories)	$199.50
Visual Back Oxygen III Filter (fits in series on back threads of SCT'S)	$199.50

Lumicon Hydrogen Beta Filters were created to enhance a select number of low energy nebulae such as the elusive "Horsehead", the "Cocoon" & the California Nebula. In many instances the Hydrogen Beta filter is the **ONLY** way to see these nebulae. The H-Beta Filter is a visual filter only, and is best suited to 8" or larger aperture telescopes with focal ratios of f/5 or faster.

1.25" Hydrogen Beta Filter (fits most 1.25" eyepieces)	$99.50
48mm Hydrogen Beta Filter (fits 2" eyepieces and Lumicon accessories)	$199.50
Visual Back Hydrogen Beta Filter (fits in series on back threads of SCT'S)	$199.50

Special Pricing – Buy two or more Lumicon filters and get a DISCOUNT.

Filters normally priced at $99.50	pay only $92.50
Filters normally priced at $199.50	pay only $185.00

SKY VECTOR™ $349!!!

Includes Computer ▪ Encoders ▪ Hardware

LUMICON Sky Vector Features:

- Just two stars to align
- "GUIDE" mode leads you to object
- No need to enter latitude, longitude etc.
- Super-accurate right ascension and declination readings.
- 4000 pulse (0.09 accuracy) encoders
- Polar Alignment NOT REQUIRED!
- Motor drive NOT REQUIRED!
- Works Equally well for Dobsonian and equatorial mount telescopes

SKY VECTOR I™ $349.00

NEW! With over 220 object memory including the 110 Messier and 58 best New General Catalog objects.

NGC-Sky Vector
MODE
ENTER
UP
DOWN
LUMICON

NGC-SKY VECTOR™ . $489.00

12,000 object memory including the corrected RNGC catalogue! PC serial port. NGC Sky Vector with IDENTIFY mode; 12,000 , IC catalogue, P&K planetary catalogue and much more.

Specify Telescope Type: Meade 4",8", 10",12" SCT, C-8, C-11, Odyssey 8", 10", 12", 17 1/2" alt-azimuth; Meade 6"-16" Dobsonian. Ultima 8", 9 1/4", 11" add $25. C-14 add $75.

Great National Brands

Meade Telescopes & Accesories

Tele Vue Scopes and Eyepieces

Celestron's Latest

Additional Lines Sold by Lumicon

- Celestron*
- Meade
- Tele Vue
- Losmandy
- JMI
- JMB Solar Filters
- Beattie Intenscreens
- Fujinon Binoculars
- Kendrick
- Telrad
- Rigel
- Pentax
- Tectron

* **Lumicon has now been officially named as THE Celestron outlet for all of Northern California.**

Prices are constantly changing on many items. Call Lumicon's toll free number to get the latest, lowest quotation on these items and more.

Attention Astronomy Clubs

You may be eligible for a 10% discount! If you are an established astronomy club, based in the U.S., you may deduct 10% from any Lumicon-manufactured product(s). This includes filters, guiders, hyperkits, sky vectors and adapters. Orders must be placed on club letterhead and paid for with a club check. Not valid on purchases of other manufacturer's products.

The Los Alamos trio is part of an international monitoring effort to detect clandestine nuclear tests by rogue nations and terrorist groups. Thankfully, the team doesn't often receive evidence for covert nuclear activity with their array of listening devices. But they do often detect signals of interest to astronomers and planetary scientists.

Earlier this summer, ReVelle and his team announced the detection of two large meteors, which slammed into the atmosphere in August 2000 and April 2001.

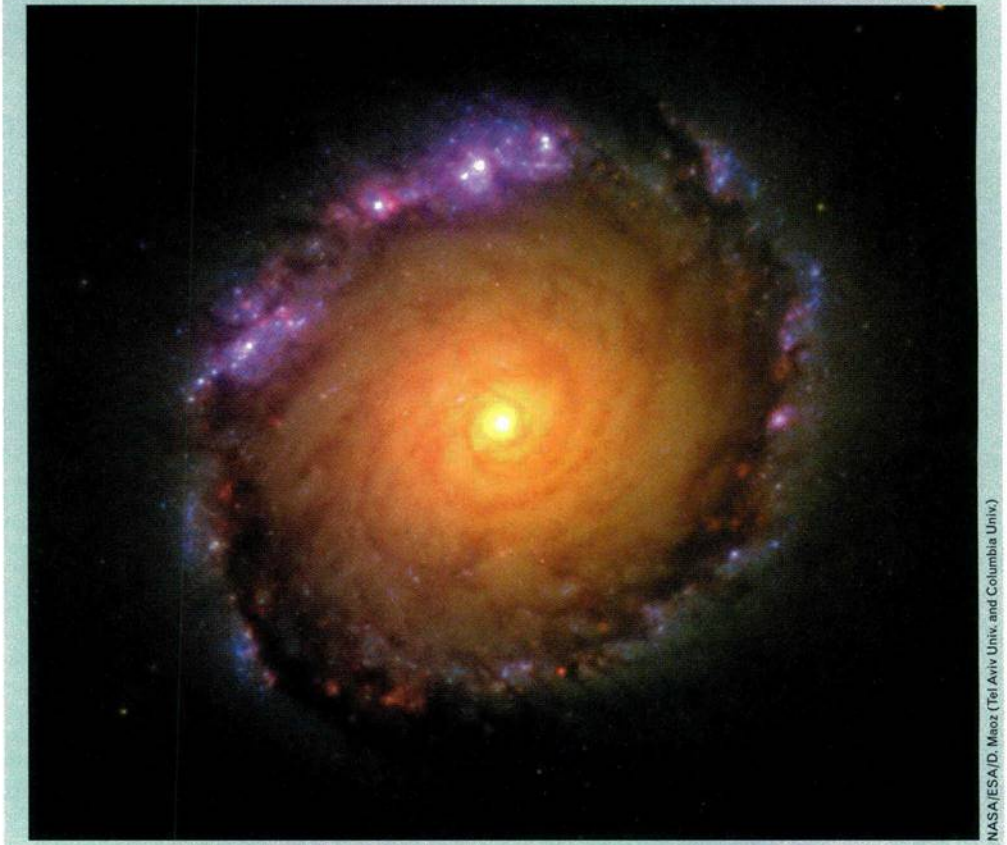
Both of these large meteors, called bolides, had diameters between six and ten feet and entered the atmosphere over the Pacific Ocean, off the coast of Mexico. Though both broke into thousands of pieces before a few, if any, slammed into the ocean, they undoubtedly crossed the sky as huge fireballs.

"Had anyone witnessed the April 2001 event, they would have seen quite a show," says ReVelle. "That meteor was one of the five brightest meteors that has ever been recorded."

When a bolide enters the atmosphere or a nuclear device is detonated, the percussion creates a sound wave that travels well below the detection limits of the human ear.

Using four infrasonic microphone arrays scattered across the United States, ReVelle and his team are able to determine the exact location and equivalent energy (measured in tons of TNT) of a meteor's arrival or nuclear detonation from the frequency of the signal and the subsequent time lag from one infrasonic detector to another.

HUBBLE SPACE TELESCOPE



NASA/ESA/D. Maoz (Tel Aviv Univ. and Columbia Univ.)

YOUNG STAR CLUSTERS STUD the impressive starburst ring that comprises the hub of the barred spiral galaxy NGC 1512. This new Hubble Space Telescope image shows that the clusters populate both dusty and void regions of the ring. The color-composite was created from seven images taken in ultraviolet, visible, and infrared light with three different Hubble instruments: the Faint Object Camera, The Wide Field and Planetary Camera 2, and the Near Infrared Camera and Multi-Object Spectrometer. The void clusters show up easily in ultraviolet and visible light and appear as bright blue clumps in the image. The dusty clusters heat the surrounding gas and dust, causing it to glow in the red and infrared. This glow appears as reddish light permeating the dark, dusty lanes in the ring. NGC 1512 lies about 30 million light-years from Earth in the southern constellation Horologium. The galaxy overall spans 70,000 light-years, though the starburst ring has a diameter of just 2,400 light-years.

The Los Alamos team calculates that the August 2000 meteor entered Earth's atmosphere several hundred miles west of the northern Baja, California region of Mexico and possessed an energy equivalent to 2,000 to 3,000 tons of TNT.

The April 2001 meteor, which came down off the coast of Acapulco, Mexico, was much larger (10 feet or more in diameter), with an energy yield equivalent to 6,000 to 8,000 tons of TNT.

About 10 meteors with diameters measuring more than six feet (the diameter of the August 2000 meteor) enter Earth's atmosphere each year.

The detection of these two bolides highlights the potential for infrasonic devices to enforce nuclear non-proliferation measures as they monitor the globe for clandestine nuclear tests. Such clandestine nuclear tests often carry energies of 10,000 tons of TNT or more. — W. S.

Online Catalog/Ordering @ shutan.com

$150 Price Reduction on ETX-90/EC w/Autostar

Compared to last year-- call for details!

70AT: Price reduced **$50** and get FREE tripod!

We Take Trades

New ETX-90's from $249

90/EC • 125/EC

Call for $$

Meade 8 inch Dobsonian **$349!**

Meade 8 inch Equatorial **$599!**

$500⁰⁰ Price drop compared to last year!

Meade LX90 & LX200

Celestron NexStar Family!

Prices Reduced on most models!

- 5"/8"/11" Cassegrain
- 4" Maksutov
- 80mm Refractor
- 4.5" Newtonian

Register Online for Exclusive E-mail Specials!

Multi-Coated! Built-in eye guards

Meade 3000 Eyepieces	
Plossl 5, 6.7, 9.5, 16, or 25mm	$50
40mm Plossl	80
Meade 4000 Eyepieces	
Zoom 8-24mm	220
Super Plossl 6.4, 9.7, 12.4, 15, 20, or 26	80
SP32 or 40mm	100
SP56mm	200
Super Wide 13.8	140
Super Wide 18	150
Super Wide 24.5	180
Super Wide 32	240
Super Wide 40	300
Ultra Wide 4.7	170
Ultra Wide 6.7	200
Ultra Wide 8.8	240
Ultra Wide 14	300

ETX Accy's:	
3ah Battery	$60
Barlow Deluxe APO	80
Case, soft deluxe	80
Case, hard 90	100
Case, hard deluxe	159
Dew shield 90	32
Dew shield 125	42
Easy-Mount	59
FlexFocus	36
KwikFocus 90	33
KwikFocus 125	33
MegaPod	239
Piggyback 90	60
Piggyback 125	75
Rigel Quickfinder	40
SCT accy adapt	32
SkyMap Pro 7.0	95
Solar filt- 60/70	68
Solar filt-dlx-90	82
Solar filt-dlx-125	104
Tele extender	32
Visual back 1.25"	32
Wide-field/deluxe	100
Call for others!	

Meade ETX Accy's:	
505 Software set	$55
506 Software set	50
Autostar #497	100
Ac adapter #541	42
Car cord #607	30
Computer cord #505	30
Case #765	42
Case #773	60
Case #774	100
Case #775	150
Dew shield #670	20
Filter set #3200	40
Finder #825	52
Finder #827	52
Focuser #1244	110
Focuser #1247	124
Prism 45° #932	50
Prism 45° #933	50
Tripod #880	32
Tripod #881	62
Tripod #882	100
Tripod #883	200
Tripod #887	350
Tripod adapt #889	90
T-adapter #64	37
T-adapter #64ST	20

Meade Accessories	
AC #541	$42
AC #542	110
Barlow 2x #140	80
Car cord #1812	90
Case 7/8/10/12"	call
Compass #605	21
Deluxe lat adjust.	26
Eyepiece holder	26
Epoch 2000 CD	179
Flip-mirror #644	150
Flip-mirror #647	250
Finder 544-8x50	72
Finder 545-8x50	72
Finder 634-6x30	52
Finder brkt-8x50	26
Filter set-1, 2, or 3	50
Filter ND96 1.25"	18
Focal reducer f:6.3	130
Focal reducer f:3.3	150
Illum 12mm Astro	120
Illum 25mm-CCD	130
Illum 12mm w/cord	80
Illum 12mm-w/batt	100
Illum 9mm w/cord	130
Illum 9mm-w/batt	150
Lenshood 7/8"	120
Lenshood 10"	129
Lenshood 12"	180
Magellan	call
Micro-Az control	28
Nebula 908 B	$80
Nebula 908 N	90
Nebula 908 O-III	100
Nebula 911 B	100
Nebula 911 N	120
Nebula 911 O-III	150
Off-axis standard	87
Off-axis deluxe	114
Pictor 201XT	399
Pictor 208XT	499
Pictor 216XT	699
Pictor 416XTE	1999
Pictor 616 filter	699
Piggy brkt 7/8"	34
Piggy brkt 10"	34
Piggy brkt 12"	50
Prism 2" 90°	105
Prism 1.25" 90°	45
Prism .96-1.25"	32
Prism 1.25" 45°	45
Skylight/seal	50
Tele ext-variable	40
T-adapt: SCT	30
T-adapt: vari-proj	40
T-adapt: 1.25"	30
Vari pol 905	50
Weight set 7" or 8"	92
Weight set 10"	99
Weight set 12"	109
Wedge 8" LX200	142
Superwedge	399

35mm Astro SLR

Fully-manual camera with interchangeable 50mm lens. Great for time exposures! **$220**

NIGHTWATCH

Astronomy Books!

We carry over 40 titles of popular astronomy books and star charts. See descriptions online or in our print catalog!

Lumicon Filters!

Deep Sky • O-III H-Beta • UHC

Canon Image Stabilized Binoculars!

New Rebates- Call

10x30 • 12x36
15x50 • 18x50

We stock 70+ models of binoculars!
See 'em at www.shutan.com

Rigel Quickfinder **$40**

Schmidling EasyTester **$32**

Telstar Laser Collimator **$100**

Starbound Astro Chair **$160**

Telrad **$42**

Losmandy	
Dove plate 7"/8"	$90
Dove plate 10"/11"	90
Dove plate 12"	135
108mm ring set/2	160
125mm ring set/2	160
177mm ring set/2	224

Solar

Lifetime Warranty!

Solar Filters!

Top-rated! Precision polished **glass.** Machined aluminum cell. Image is yellow-orange— no need for secondary filtering!

ETX-60/70	$68
ETX-90	82
ETX-125	104
NexStar-5	104
6" full aperture	119
8" full aperture	139
10" full aperture	159
12" full aperture	189

Kendrick

Dew Removers	
12v Controller	$70
110v adapter	65
1.25" heater	37
2" heater	39
3" heater (ETX)	42
7/8" heater	52
9"/10" heater	62
12" heater	72

Kwik Focus!	
ETX90	33
ETX125/Nexstar5	33
8" SCT	47
10" SCT	57

Dew Shields!	
ETX90mm	27
ETX125/Nexstar5	34
7"/8"	54
10"	64
12"	85

JMI

Zero-Image Shift Focusers!

For all 5"-16" Meade or Celestron Schmidt-Cassegrains!

NGF-S w/motor	$269
NGF-SE w/o motor	169
For Newtonians:	
RCF1 Mini 1.25"	79
NGF3 Mini 1.25"	99
NGF DX3 2-inch	159
Leveling Wheels: for most Meade and Celestron	169
For 12" Meade	229

Promaster

Hardshell Acc'y Cases

Use for cameras, telescope accessories and more! Carrying handle, wide shoulder strap, metal reinforced corners, keyed latches and metal hinges. Supplied with pluck-foam insert as well as a set of rigid dividers so you can customize the case to best fit your needs.

Three sizes: 9x15x5" **$59.95**
12x17x5" **$79.95** • 12x21x6" **$99.95**

Celestron Binoculars!	
7x50 Ultima	$229
8x56 Ultima	269
9x63 Ultima	329
10x50 Ultima	229
20x80 Deluxe	449

Software

Buy any 2: Save 10%	
The Sky L2 PC	$129
The Sky L4 PC	249
Redshift-3 Mac	49
Redshift-4 PC	49
StarryNight Pro	129
Starry Backyard	49
SkyMap Pro 7	95

LX200 *Easy-Mount*

11x 20" $105

- A must for all LX owners
- Fits 7"-12" Meade scopes
- Bumper-type registration
- 1/4" anodized alum-CNC
- Holds 12 eyepieces!
- Holds keypad securely

TeleVue-102 • TeleVue 85 Pronto • Ranger

Pronto PGO	$775
TV85 OG3	1630
TV102 outfit	2550
Quick Point	40
Starbeam SFT	205
2" Everbrite	255
1.25" 90° diag	80
1.25" Everbrite	175
Zoom 8-24mm	214
Plossl-50°	
8, 11, or 15	84
20 or 25mm	97
32 or 40mm	114
55mm	230
Radian-60°	
3, 4mm ea.	230
5, 6, 8mm ea.	230
10, 12mm ea.	230
14, 18mm ea.	230

Panoptic-68°	
15mm	$210
19mm	240
22mm	280
27mm	330
35mm	365
Nagler-82°	
4.8mm	175
7mm	220
9mm Type6	280
12mm Type4	340
16mm Type5	320
17mm Type4	370
22mm Type4	445
31mm Type5	599
Barlows	
1.25" 2x or 3x	109
1.25" 2.5x or 5x	180
2-inch 2x	170
2-inch 4x	265

2001
SHUTAN

Order Toll-Free or Online! Call us or visit our web site for **2001 Discount Catalog!** Order by **NOON** for same-day shipment. C.O.D. available, please inquire. We ship most accessory orders up to 5 lbs. for just **$7** via UPS Ground. **Non-Meade** products are available for **Worldwide** shipment-- information at www.shutan.com. Shutan is family **owned** and **operated** since 1918! Prices, specifications, and trade-in offers subject to change and do not include shipping/handling. **© 6/2001 SC&V.**

SHUTAN
camera & video

We welcome bids & PO's from Schools!

Toll-Free 800-621-2248

Illinois 847-367-4600 • www.shutan.com
100 Fairway Dr. • Vernon Hills IL • 60061

We Moved!

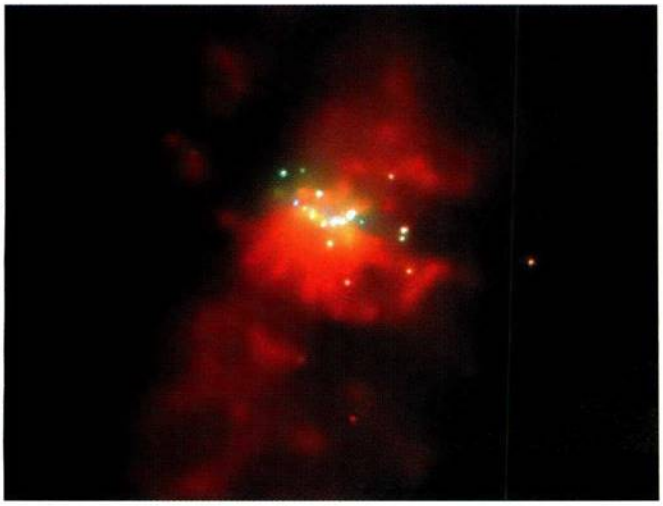
STAR FORMATION

Of Starbursts and Black Holes

▶ When the poet T. S. Eliot wrote, "In my beginning is my end," it's doubtful that he could have fully understood the cosmic impact of his words. But now, x-ray astronomers are beginning to uncover striking connections between star birth and stellar grave markers — black holes. New results from NASA's Chandra X-ray Observatory suggest that vigorous star formation activity (called a starburst) is crucial for the production of mid-mass and supermassive black holes.

Starburst galaxies are characterized by unusually high rates of star formation and subsequent stellar explosion. Often, the formation process is so violent in starburst galaxies that bubbles of hot gas escape their galactic confines.

One team of researchers has found that we don't have to look far to see similar processes in action.



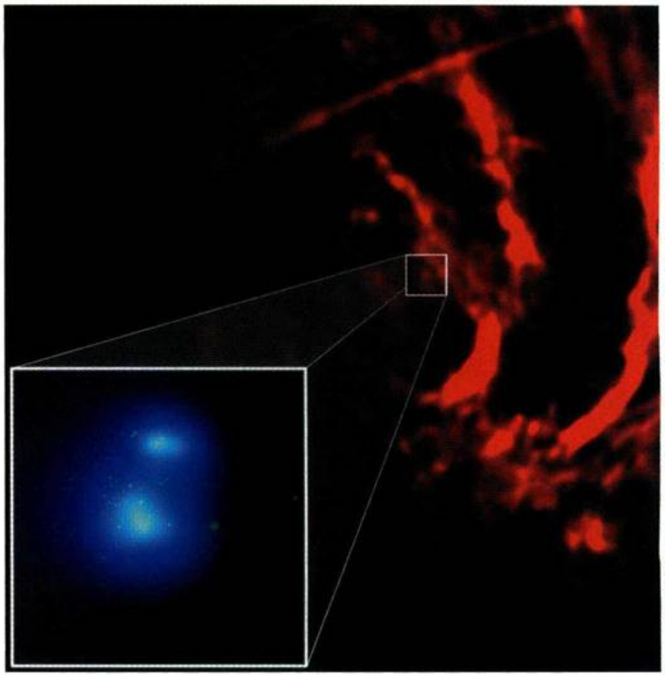
Do massive black holes power luminous x-ray sources in M82?

NASA/CXC/SAO/PSU/G. Garmine, R. Griffiths (CMU)

Northwestern University astronomer Farhad Yusef-Zadeh and his colleagues recently aimed Chandra at the Arches star cluster, located 25,000 light-years away and less than 100 light-years from the suspected supermassive black hole at the center of the Milky Way Galaxy. With 150 hot stars packed into a volume no larger than one light-year in diameter, the Arches cluster is the most compact star cluster known in the galaxy. And it's one of the youngest too, with an estimated age of 1 million to 2 million years.

Yusef-Zadeh's team, which includes Harvard-Smithsonian Center for Astrophysics astronomer Casey Law, is the first to monitor collisions between winds of neighboring stars in the Arches cluster. The team has found that these collisions are heating interstellar gas by 60 million degrees, and that the process may be so energetic that gas is currently escaping the cluster, much in the same way that gas escapes from starburst galaxies.

"The Arches cluster is one of the best 'local' analogs of starburst galaxies — the most prodigious stellar nurseries known," says Law. The relative proximity of the Arches cluster makes it a perfect tool to understand what's going on in distant starburst galaxies.



The Arches cluster glows in radio, infrared, and x-ray (inset) radiation.

X-ray: NASA/CXC/Northwestern/F. Zadeh, IR: NASA/HST/NICMOS, Radio: NRAO/VLA/C. Lang

Three teams of astronomers are also using Chandra to probe the relation between starburst episodes and the formation of mid-mass black holes — those with masses between 10 and 1,000 times that of the sun. So far, they've monitored several starburst galaxies, including NGC 253 and M82, and uncovered dozens of so-called ultra-luminous x-ray sources — point-like x-ray sources 1,000 times more luminous than similar objects found in the Milky Way. The astronomers believe that this radiation results from matter accretion onto mid-mass black holes.

NASA Goddard Space Flight Center astronomer Kimberley Weaver and her team observed the starburst galaxy NGC 253, located about 10 million light-years from Earth. There, they detected a high concentration of ultra-luminous x-ray sources — at least four sources within 3,000 light-years of the galaxy's core.

"This may imply that these mid-mass black holes are gravitating toward the center of the galaxy where they could coalesce to form a single supermassive black hole," says Weaver.

Although no widely accepted formation model for these objects exists, such mid-mass black holes could form out of the direct collapse of a very massive gas cloud or from the coalescence of a cluster of stellar-mass black holes.

An alternative explanation has been offered by Harvard-Smithsonian astronomer Giuseppina Fabbiano. She believes that x rays from these ultra-luminous sources may actually be beamed toward Earth, implying that they possess merely 10 times the mass of the sun rather than thousands. — W. S.

Space systems operating far from home simply have to work. The Next Generation Space Telescope (NGST) will be tasked to look beyond the limits of scientific imagination, but do so within the limits of precise operational parameters.

TRW has been building dependable space science systems for 40 years. Our spacecraft routinely surpass expectations. Our deployable elements have delivered 100 percent mission success. TRW and our NGST teammate, Ball Aerospace, have built in success on each of NASA's great observatories launched to date: prime contractor on Compton Gamma Ray Observatory and Chandra; corrective optics and science instruments for Hubble. And the achievements of the Space Infrared Telescope Facility's cryogenic telescope are just ahead.

Today the TRW/Ball team is working with NASA and the international science community to develop a Next Generation Space Telescope that users can depend on – a reliable conduit between the secrets of deep space and the scientists eager to discover them.

TRW: Because you don't get a second chance.

© 2001 TRW Inc.
ISO 9001 Registered

www.trw.com

TRW

EARTH SCIENCE

By the Light of the Moon?

▶ You can't get drunk from it, but it sure is intoxicating to some space scientists.

"Earthshine" illuminates the otherwise dark portion of the crescent moon as sunlight reflects from Earth's surface, onto the shaded lunar surface, and back again. It provides researchers with an indirect way of measuring Earth's albedo — the percentage of sunlight reflected.

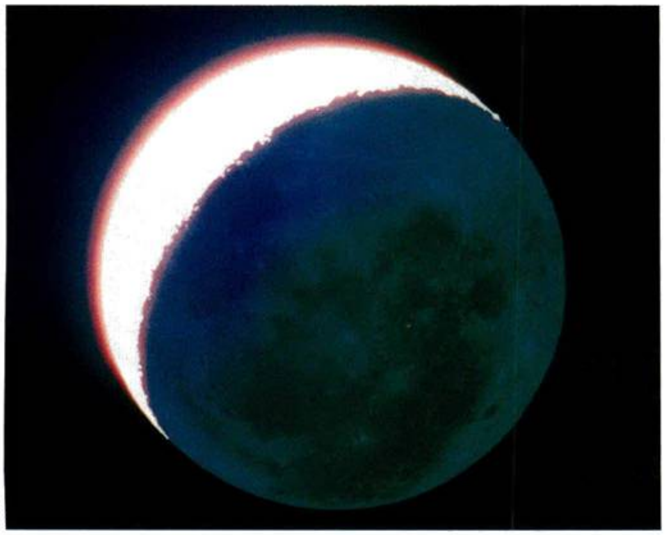
Leonardo da Vinci first described earthshine when he compared the moon to a giant mirror of sunlit Earth. In 1926, French astronomer Andre Louis Danjon first studied it scientifically. But it wasn't until nearly half a century later that Caltech astronomer Steven Koonin recognized that earthshine might also serve as an indicator of our planet's changing climate. Long-term observations of earthshine, he thought, could reveal variations in cloud cover and the density of atmospheric particles known as aerosols, which are both known to influence global climate.

"Studies of climate change require well-calibrated, long-term measurements of large regions of the globe," says Koonin. "Earthshine observations are ideally suited to this task because they are self-calibrating, easily and inexpensively performed from the ground, and instantaneously cover a significant fraction of the globe."

Within the last few years, scientists from the New Jersey Institute of Technology and Caltech have teamed up with the Big Bear Solar Observatory outside Los Angeles to regularly observe earthshine.

The team reports that their earthshine observations indicate that Earth reflects about 30 percent of the sunlight it receives. With a multi-station earthshine observing network on the drawing board, the team hopes to study El Niño events, volcanic eruptions, and global climate variability. — PAUL MORLEDGE

Cosmic mirror: There is much to learn from Earth's reflected glow.



Nelson Falsarella

Speedy Delivery?

If patience is a virtue, internet astronomy enthusiasts should be granted sainthood. Could it take any longer to download the latest images of your favorite nebula? Thanks to the work of two astronomers, those days of waiting may soon be forgotten. University of Wisconsin astronomer Jeffrey Percival and Space Telescope Science Institute colleague Richard White, have developed software that can cut high-resolution image delivery by 10 to 100 times. By sending only the most important information first, high-quality images are created in a fraction of the time. The software is born from the need to quickly transmit astronomical data as remote observing gains popularity among astronomers.

British Flying Saucer Bureau Closes

"I'm just as enthusiastic about flying saucers as I always was, but the problem is that we are in the middle of a long, long trough," says Denis Plunkett, who founded the British Flying Saucer Bureau with his father Edgar in 1953. Back in the good old days, the bureau boasted a thousand members and would receive dozens of UFO reports every week. Today, Plunkett attributes the sharp decline of UFO reports and bureau members to the end of the Cold War. With the threat of nuclear devastation less imminent and the world generally a safer place, he thinks alien visitors may have lost interest with observing humans. Perhaps they've moved on to bigger and better things?

John Chumack

Help Wanted: Aliens should contact the British Flying Saucer Bureau for details.

Back to School for NASA Robots

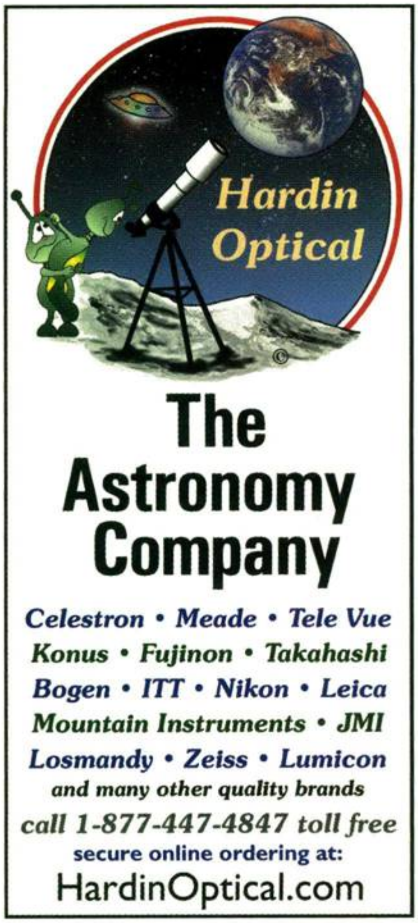
NASA robots are pretty dumb. Although capable of impressive feats, robotic probes are entirely dependent upon their earthly operators and lines of command code embedded in their software. But now, NASA is schooling the next generation of robotic probes in the fine art of thinking. The headmaster of NASA's robotic school of deep thought is Jet Propulsion Laboratory artificial intelligence expert Ayanna Howard. By outfitting future robonauts with neural networks (complex design structures that foster the ability to learn from experience), Howard hopes that her pupils will one day traverse the surface of an alien world much better than if under the control of remote operators. "We want to tell the robot to think about any obstacle it encounters just as an astronaut in the same situation would do," says Howard.

Get your paws on a new telescope from Starizona!
Rigel the Astro Cat

STARIZONA
ADVENTURES IN ASTRONOMY AND NATURE

Southern Arizona's Celestron Showcase Dealer

5201 N. Oracle Rd.
Tucson, AZ 85704
520-292-5010
starizona.com



The Astronomy Company

Celestron • Meade • Tele Vue
Konus • Fujinon • Takahashi
Bogen • ITT • Nikon • Leica
Mountain Instruments • JMI
Losmandy • Zeiss • Lumicon
and many other quality brands
call 1-877-447-4847 toll free
secure online ordering at:
HardinOptical.com

VISIT US AT:

AstronomyQuest.com
4790 Irvine Blvd. Irvine, CA 92620
(800) 807-8763

Ever Feel Like Your Equipment is Getting Out-of-Date

CELESTRON
DISCOVERY TELESCOPES
Meade THE LEADER'S EDGE
LUMICON

Telescopes
Binoculars
Software

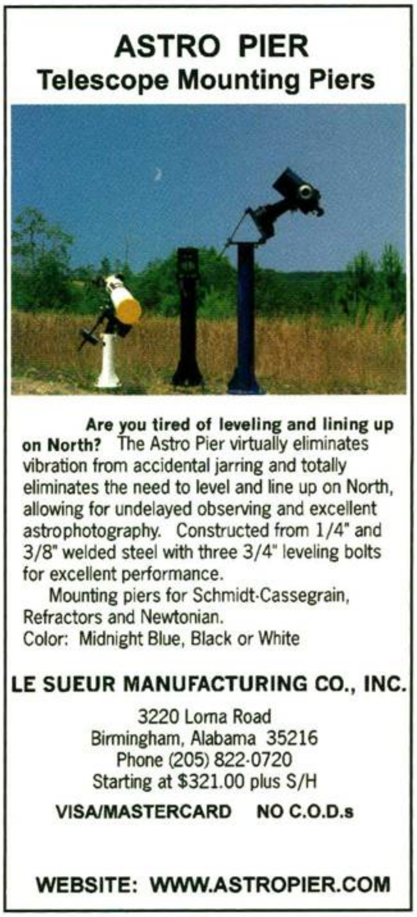
Microscopes
Books
Posters

FREE-SHIPPING On Most Things We Sell!
Free Catalog
www.AstronomyQuest.com

KENDRICK ASTRO INSTRUMENTS

Dew Removal Systems
Dewcaps
Observing Chairs
Power Packs
Laser Collimators
Baader Solar Filters
Kwik Focus
Coronado H-alpha filters

Order on-line
www.kendrick-ai.com
or call 1 800 393 5456


ASTRO PIER
Telescope Mounting Piers

Are you tired of leveling and lining up on North? The Astro Pier virtually eliminates vibration from accidental jarring and totally eliminates the need to level and line up on North, allowing for undelayed observing and excellent astrophotography. Constructed from 1/4" and 3/8" welded steel with three 3/4" leveling bolts for excellent performance.

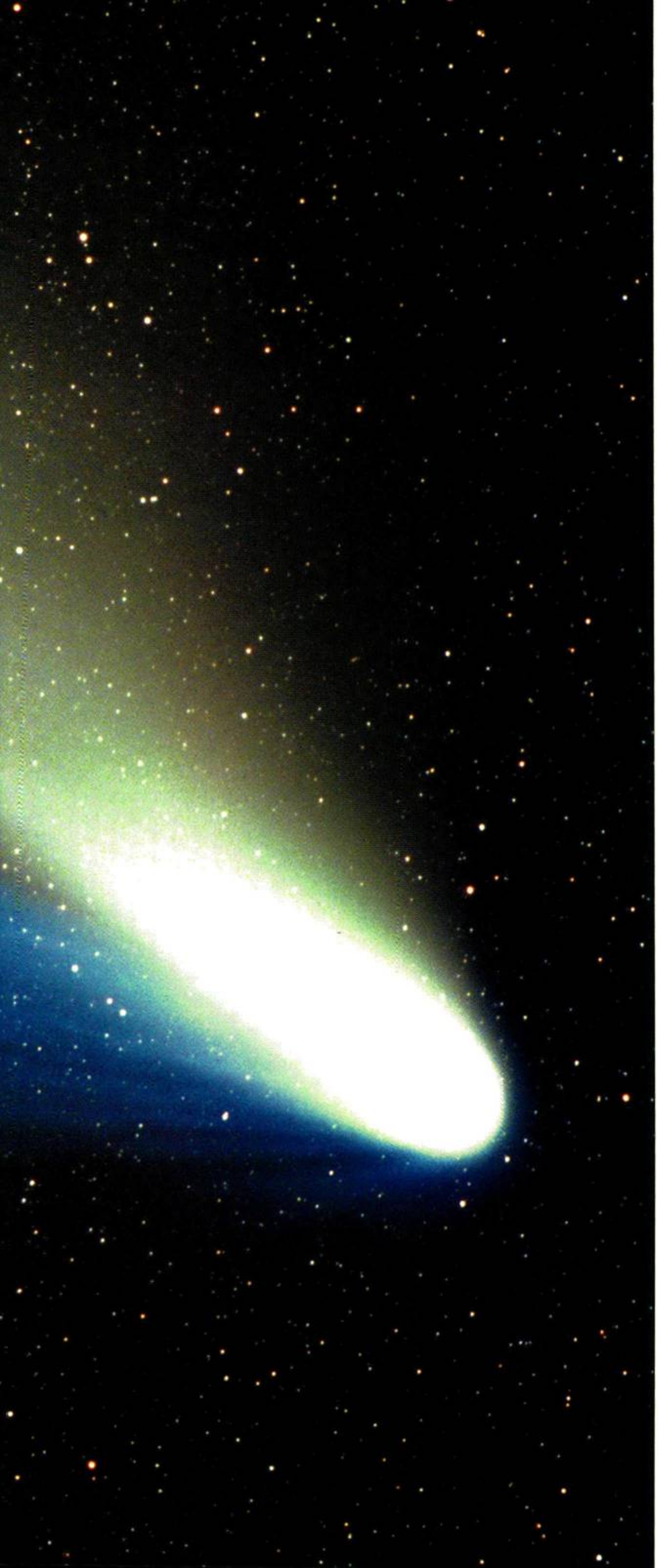
Mounting piers for Schmidt-Cassegrain, Refractors and Newtonian.
Color: Midnight Blue, Black or White

LE SUEUR MANUFACTURING CO., INC.
3220 Lorna Road
Birmingham, Alabama 35216
Phone (205) 822-0720
Starting at $321.00 plus S/H
VISA/MASTERCARD NO C.O.D.s

WEBSITE: WWW.ASTROPIER.COM

chasing a COMET

by William Speed Weed



Jerry Lodriguss

Controversies about comets' contributions to Earth heat up this month when a NASA spacecraft visits Comet Borrelly.

by William Speed Weed

On July 29, 1999, an advanced NASA satellite about the size of a refrigerator with solar-panel wings flew within 6 miles of an asteroid. The asteroid had been designated 1992 KD, but it was renamed Braille for the flyby. Unfortunately, the Deep Space 1 (DS1) satellite's automated tracking system couldn't find it. Maybe it was poetic justice for naming the rock after the blind inventor of a system of printing and writing used by the blind.

A week later, the $152-million satellite took a couple of fuzzy images of the dumbbell-shaped Braille, fired up its solar-electric propulsion system, and sped off toward its next target — Comet Wilson-Harrington. But the Wilson-Harrington flyby was canceled in November 1999 after the satellite's star tracker navigation system stopped working.

The star tracker had used the background pattern of stars to orient the satellite. "It should have been a mission-ending failure," says Marc Rayman, NASA's project manager for DS1. Rayman's team quickly found a way for DS1 to use its science camera, with a field of view one-hundredth that of the star tracker, to steer the satellite. Like a visually impaired person using a cane for the first time, DS1 set off a little unsteadily toward this month's rendezvous with its last, and most important, target — Comet Borrelly.

The comet, whose orbit is tilted 30° from the plane of the solar system, crosses the ecliptic on September 22. Old, handicapped — and not even designed for comet research — DS1 actually may double our knowledge of the most beautiful and scientifically interesting objects in the solar system. When DS1 meets up with Borrelly this month, it will demonstrate that inventive scientists and engineers often accomplish much more than some people might expect.

This view of Halley's Comet taken in 1986 is among the best views of a comet's nucleus.

ESA

Overachieving Objects

Most comet nuclei are only a mile or two in diameter, and far from the sun they usually are incredibly dim. But close to the sun they are just as hard to observe because they are hidden behind luminous shrouds of gas and dust. These smoke-like shrouds, called comae, can be 600,000 miles (960,000 km) in diameter, filling more space than the sun, and tails extending from them can be millions of miles in length. Comet Hyakutake's tail was measured in 1996 to be a whopping 350 million miles (570 million km) long. But when it comes to the source of all the fireworks — the comet nuclei themselves — planetary scientists are groping for answers. It's amazing they know anything about these reclusive overachievers.

Getting close enough to see a comet nucleus — as DS1 intends to do — is vitally important to understanding them. At closest approach, the spacecraft will be about 1,250 miles (2,000 km) from the nucleus. Borrelly will shoot past DS1 at 10 miles per second, which may seem heart-stoppingly fast, but which dynamists consider plodding for such a flyby.

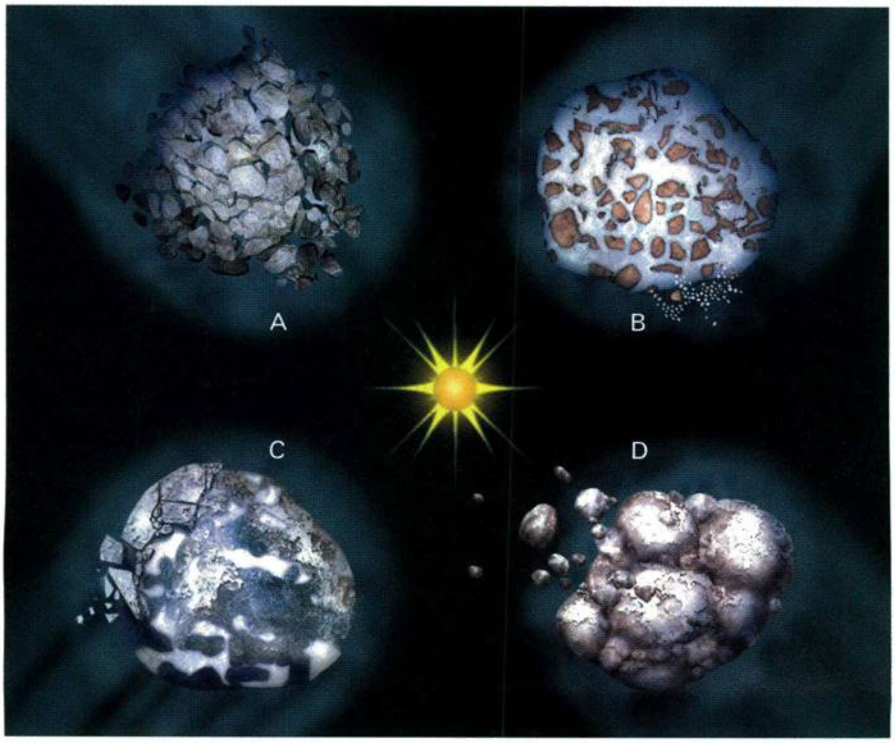
In 1986, the European Space Agency's Giotto spacecraft flew within 373 miles (596 km) of Halley's nucleus at 42 miles per second; however, photographing Halley was extremely difficult because the satellite couldn't track the fast-moving target. Giotto snapped multiple images as Halley's nucleus passed across the satellite's field of view for brief periods. Scientists on the ground then combined the individual photographs.

The Soviet Union's Vega 1 and 2 probes joined Giotto during the 1986 rendezvous, and the instruments aboard the three spacecraft confirmed astronomer Fred Whipple's 1950 dirty-snowball theory. The probes also found that the snowballs were dirtier than expected. "They are the kind of snowball that the nasty kid down the street would make; full of sand and rocks and other stuff," says Tom Duxbury, a NASA investigator on the Stardust mission, which will meet comet Wild 2 in 2004.

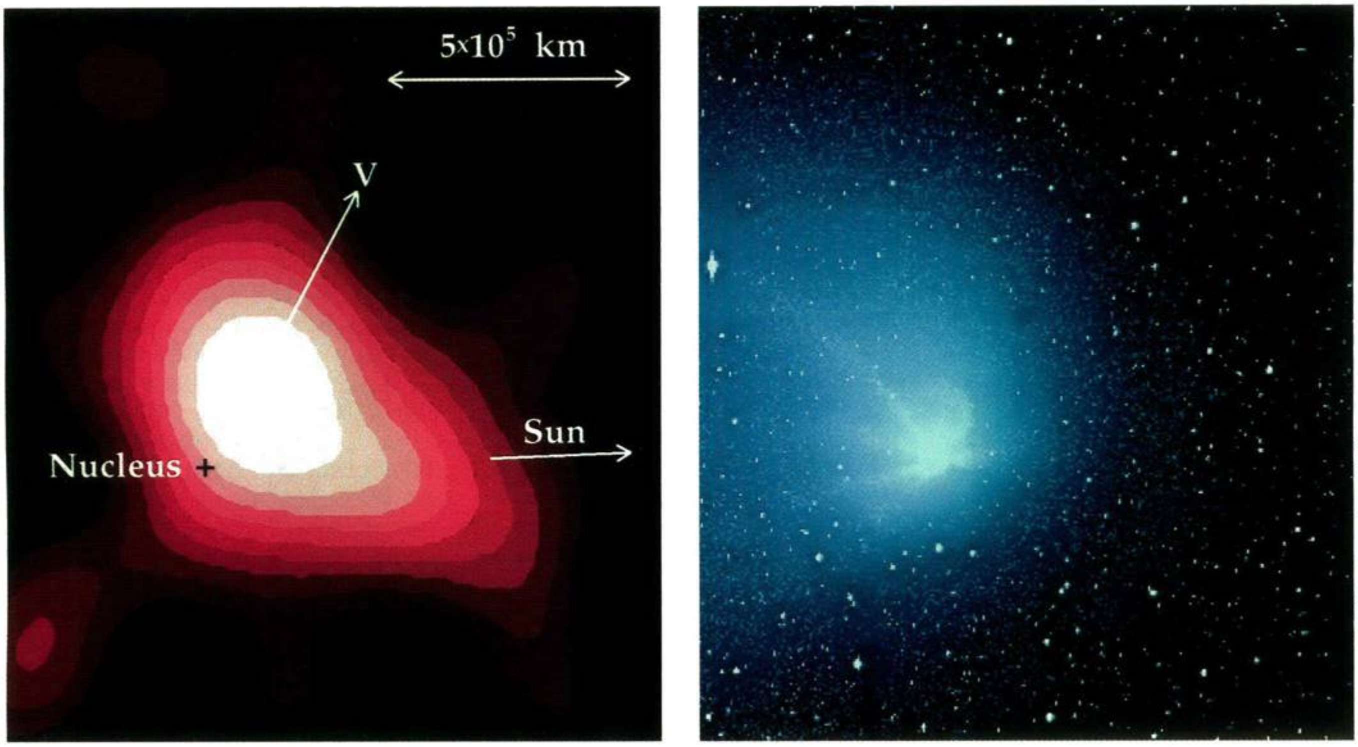
The Vega and Giotto probes found an abundance of water, gases, and primitive grains rich in elements that made up the solar nebula at the time the solar system was forming. The probes also detected complex hydrocarbons, the raw materials for life.

Close-up photographs also revealed that Halley was oddly shaped, not spherical as some had expected, and covered with organic soot as if it had rolled down a dirty chimney. Astronomers think organic molecules from comets can be deposited on Earth directly via impacts, or from the steady "precipitation" of particles from innumerable comet tails.

The "dirty" part of Halley also includes silicate grains similar to what scientists find in meteorites. These ancient granules coalesced in the same process that built the planets about 4.6 billion years ago, and comets are thought to hold the last pristine collections of these particles. Planetary scientists still know little about how the tiny grains coalesced or what they may reveal about the origins of the solar system.



Exactly what does a comet's nucleus hold? Does it consist of an icy conglomerate (A), an aggregate of flaky material (B), packed debris (C), or a composite of blocks of varying sizes stuck together by ice (D)?



Optical image: Univ. of Hawaii; x-ray image: EUVE

Comet Hale-Bopp imaged in mid-September 1996, showing x-ray and optical emission.

"Comets are the least understood objects in the solar system," says Donald Yeomans, a NASA comet expert who, nonetheless, published a dictionary-sized tome on the subject. "And they're probably the most important when it comes to you and me." Within their well-shrouded nuclei, comets harbor answers to how our solar system formed, how life on Earth got its start, and how humans might avoid the sort of environmental cataclysm that doomed the dinosaurs 65 million years ago.

Closing In on Borrelly

Borrelly orbits the sun once every 6.86 years, which makes it a short-period comet. The mass and density of Borrelly are unknown, but its elongated nucleus is estimated to be fairly large — 5 miles (8 km) at its longest and 1.8 miles (3 km) at its narrowest. Borrelly's orbit, in the same direction around the sun as the planets and asteroids suggests it probably migrated in from the Kuiper Belt. This disk, which includes Pluto, contains a vast number of primordial icy objects that formed at roughly –400° F — the coldest region of the solar system beyond Neptune.

On the contrary, Comets Halley, Hale-Bopp, Hyakutake, and LINEAR (C/1999 S4) formed closer to the sun (roughly at the position of Jupiter's orbit) at a balmy –190° F. These comets were gravitationally jostled from their birthplace out to the Oort Cloud, a vast realm of similarly ejected comets that extends about one-third the way to our closest stellar neighbor.

"There is no reason to assume that all comets should have the same elemental abundances," says Michael Mumma, chief scientist for planetary research at the Laboratory for Extraterrestrial Physics at Goddard Space Flight Center in Greenbelt, MD.

comets are the least understood objects in the solar system.

This difference in origin between an Oort Cloud comet, such as Halley, and a Kuiper Belt Object, such as Borrelly, is why planetary scientists are excited to finally be able to compare the two. Planetary scientists agree that all comets are mostly water ice, with other frozen gases — carbon dioxide, carbon monoxide, ammonia, and methane. "I think it is quite likely that most, maybe all, the carbon and nitrogen on Earth came from comets," says Tobias Owen, an astronomer at the University of Hawaii and a comet expert. "But I don't think that you can argue that all the water got here from comets."

Owen's view is based on detailed examinations of Comets Halley, Hale-Bopp, and Hyakutake, which show that all three contain nearly identical concentrations of "isotopically heavy" (deuterium-containing) water. The ratio of deuterium-to-hydrogen — one of several chemical fingerprints for solar-system objects — is twice as high in comets as it is on Earth. Owen and many planetary astronomers say the difference shows that comets are not the primary source of Earth's water.

However, Mumma and retired University of Toledo astronomer Armand Delsemme are two members of a vocal minority of planetary scientists who disagree with Owen. They are convinced that Earth received all of its water from comets such as LINEAR that formed in the warmer region of the solar system near Jupiter. Delsemme wrote in a 1998 paper in *Planetary and Space Science* that there is "no doubt in my mind that seawater was entirely brought to Earth by comets, and prebiotic molecules by interplanetary particles derived from cometary tails."

X-ray Surprise

Indeed, comets are more surprising than many astronomers thought possible only a few years ago. For example, a group of planetary scientists led by Carey Lisse at the University of Maryland discovered in 1996 that Hyakutake produced x rays as it neared the sun. "It was a big surprise," says Mumma. "Comets are so cold you wouldn't expect x rays to be coming from them, especially at such high intensities." Subsequent studies confirmed that cometary x rays are produced when hot ions in the solar wind exchange energy with neutral atoms in cometary comae.

Of course, comets don't always appear luminous and fiery. It's only when they sail inside the orbit of Jupiter that sunlight is strong enough to heat them significantly. Warmed, their ices sublimate, sputtering and fizzing from fissures in the nucleus. These geysers spewing gases and dust would dwarf Yellowstone National Park's Old Faithful. Solar radiation pushes the dust particles into a yellowish tail, and ionized gases are carried away by solar magnetic fields as blue plasma tails.

you wouldn't expect x-rays coming from *comets*

Of course, the nucleus is the business end of every comet. It's why DS1 has swung into position near the orbit of Mars to get a close look at Borrelly. But Rayman downplays expectations of September's rendezvous. "DS1 wasn't built for a comet flyby," he says, "and it's a handicapped craft." But if all goes well, it should take pictures of the nucleus with a resolution of about 300 feet (90 m) — slightly better than Giotto's resolution of Halley.

Just as the Giotto and Vega 1 and 2 spacecraft did, DS1will use an instrument called a mass spectrometer to measure the chemical compositions of neutral gases, ions, and particles. Even if DS1 doesn't outperform Giotto and Vega, researchers are excited to have some data. "How much like Halley is this thing?" Yeomans asks.

DS1 is the first in a planned series of comet flybys. In 2004, Stardust will rendezvous with Comet Wild 2 and return to Earth with cometary and interstellar dust. Two other missions — Deep Impact and Rosetta — will send probes into comet nuclei in 2005 and 2011, respectively. (The name Rosetta refers to the Rosetta stone, which helped 19th century French scholar Jean-François Champollion decipher Egyptian hieroglyphics.) NASA's $154-million CONTOUR (comet nucleus tour) mission will fly within 60 miles of at least three near-Earth comets — Encke, Schwassmann-Wachmann-3, and d'Arrest — from 2003 to 2008, taking images, making spectral maps, and analyzing the dust of the three short-period comets.

The goal of all the missions is to understand how comets work and to analyze the infant solar system. Take, for instance, the small-scale structure of how the gas and dust leave a comet nucleus. We have a fairly good idea that material comes off in "jets" — gas and dust spewing into space from each comet's surface. As comet nuclei rotate, the jets sweep around, subtly diverting the paths of comets from their predicted orbits. "They make unauthorized trajectory correction maneuvers," says Rayman in NASA lingo.

These jets must have lots of oomph, possibly concentrating the outflow of sublimating gas into columns. Giotto's images of Halley show that only 10 percent of the sun-facing surface had jets. Scientists think that a closer analysis will reveal that jets are located at fissures in the nucleus that mark boundaries between the planetesimals that built the comet in the first place.

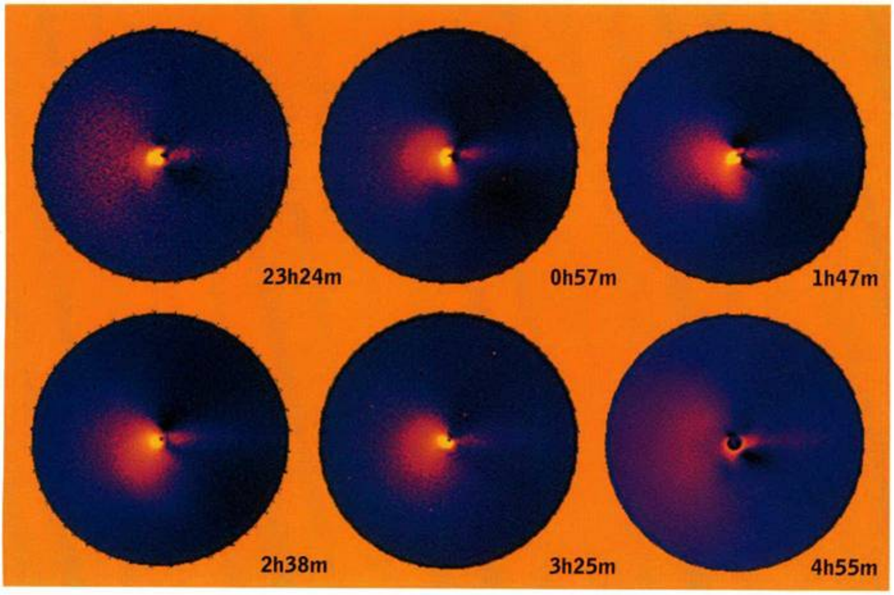
It's vital to understand comets for a pragmatic reason: possibly our survival. Even a little comet could cause environmental havoc if it were to strike Earth. Our planet has experienced several mass extinctions, the most recent one 65 million years ago that wiped out the dinosaurs and many other forms of animal and plant life. A comet or asteroid impact may have triggered one or more of the extinctions.

Scientists need to know the internal structure of comets in order to deflect them from a collision course with Earth. According to scientists like Yeomans, we won't know what they are until we get close to them.

Breaking Up Is Easy

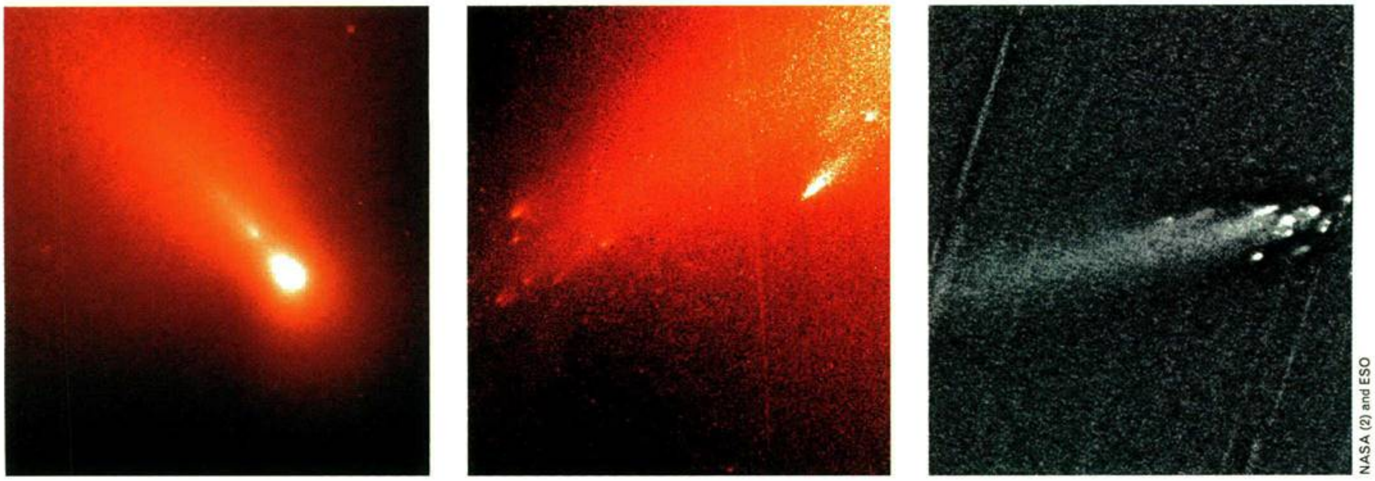
Some comets crumble like cookies. Comet West broke into at least four pieces after it rounded the sun in 1976. Comet Shoemaker-Levy 9 broke into more than 20 fragments that plopped into Jupiter, one after the other, in 1994. And Comet LINEAR (C/1999 S4), an Oort Cloud resident making its first close passage around the sun, shattered after it rounded the sun in July 2000.

The LINEAR break-up provided another bonus: By completing chemical-fingerprint analyses of its debris, scientists found that the comet had formed between Jupiter and Saturn. The break-up of LINEAR and other comets also reveals how weakly some comet nuclei are held together. Some are so soft that only gravity keeps them from flying apart. Yeomans says that Shoemaker-Levy 9 would have broken into frozen pieces in your hand with only modest pressure.



Laurent Jorda and Jean Lecacheux/Pic du Midi Observatory

Striking images of the nucleus of Comet Hyakutake taken on March 18/19, 1996, show the comet's rotation and jetting activity over a period of five-and-a-half hours. The times given are in universal time.



NASA (2) and ESO

Fragmenting comets such as LINEAR (C/1999 S4) offer an incredible spectacle as they come apart in the sun's warmth. In this series, LINEAR unravels progressively on July 21, August 5, and August 6, 2000, as imaged by ground-based telescopes.

"We'd like to know what they're made of," says Yeomans, because "the way you'd deflect a soft mushy snowball is different from the way you'd deflect a rock." You don't want to take a baseball bat to a snowball — you'll just shower the umpire in snow.

"Comets have certainly been a frustrater of life when they've impacted the Earth," says University of Texas astronomer Anita Cochran, "but they've also probably been an enabler of life too." Comet experts such as Cochran would like to know exactly what comets are made of in order to say what their roles might have been.

The Right Stuff

Many scientists are convinced that comets have the right stuff for life. NASA astrobiology researcher Lou Allamandola has built artificial comets in his laboratory by freezing water, carbon dioxide, ammonia, and other ingredients in a vacuum chamber and bombarding the ice with ultraviolet light. His homemade comets have spontaneously generated quinones, ketones and polycyclic aromatic hydrocarbons — building blocks of amino acids that comprise proteins, which are the workhorses of life.

Another researcher, University of California, Berkeley's Jennifer Blank, simulated high-impact comet collisions. Her results were in themselves striking. Not only did organic molecules survive the crashes, they used the energy to form more complicated structures.

Rendezvous

When DS1 is at closest approach to Borrelly, it will be mid-afternoon in North America. But the comet can be viewed later that evening through a telescope (magnitude 9). Deep Space 1 of course will be undetectable. For a viewer at 40° N latitude, the comet will rise at 1:30 A.M. (daylight savings time) in the constellation Gemini, about 7° south and a little east of the bright star Pollux (right ascension 7h54m, declination 2047', epoch 2000.0 coordinates).

Still, Allamandola's and Blank's efforts are limited by assumptions of what comets are made of. "The molecules in comets are the building blocks for amino acids," says Cochran. "Can they be built up in the comet? Or on the way down? We know that comets brought material, but was it the critical material to make you and me? Who knows?" Scientists involved in DS1 and other comet-rendezvous missions are asking those questions and many others. Nineteenth-century French educator Louis Braille, who didn't allow his blindness to limit him, would probably have encouraged modern scientists to intensify their search for answers.

William Speed Weed — yes, it is his real name — is a freelance magazine and radio reporter and a contributing editor for Discover *magazine.*

Leo Enright

Observers who enjoyed Comet Hyakutake's enormously long tail await the approach of another, similarly-bright comet.

Probing the Birth

By discovering how stars shine, Hans Bethe became a 20th-century luminary.

by Adam Frank

The door to the modest apartment swings open and I am greeted by a trim, gracious woman whose bright eyes belie her age. This is Rose Bethe, Hans Bethe's wife of 76 years. A moment later, Bethe himself appears. His eyes are a moist, pale blue and the few wisps of white hair surrounding his head frame an abundant smile.

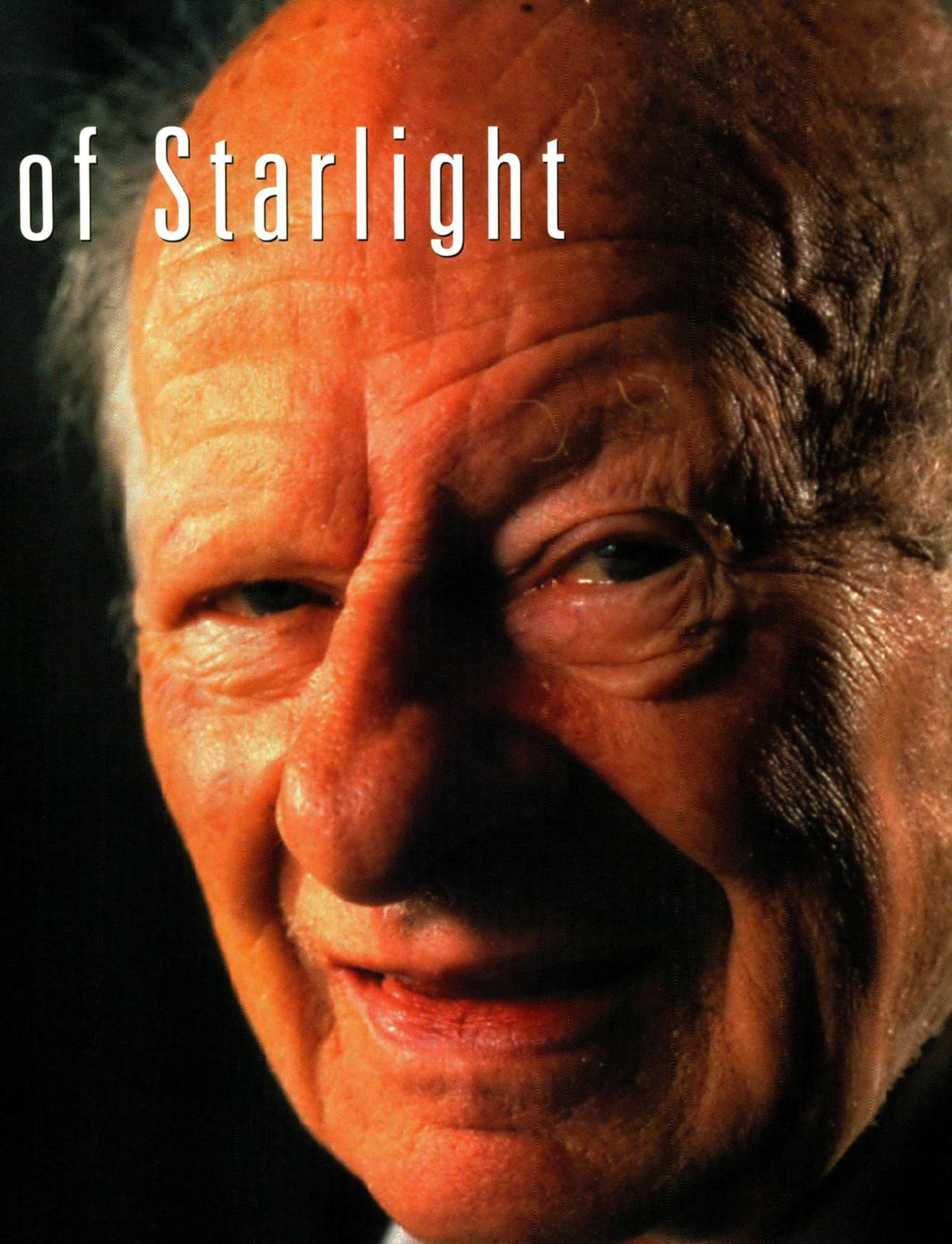
"Ah, good morning and welcome," he says with a noticeable German accent. Rose guides us to a pair of chairs and there is a moment of settling in (the man is 94 years old, after all). I tell him that I want to ask him some questions about his life and work, specifically his work on stellar fusion and supernovae. Before I can pull out my pad of prepared questions, Bethe starts his story. He begins, methodically, at the beginning. Immediately it's clear that I should put my questions away. This is an oral history of the kind I am likely never to hear again.

Hans Bethe (pronounced BAY-tah) is, without argument, one of the greatest physicists of the 20th century. He helped create modern atomic and nuclear science. He served as head of theory for the Manhattan Project. He is a man who has seen — and made — a lot of history. In astrophysics, Bethe's most significant contribution was the theory of stellar energy generation. In essence, he figured

Hans Bethe explained how lightweight atoms come together to generate the prodigious energy of massive stars.

Robert Barker/Cornell University

# of Starlight



European Southern Observatory

The hot, massive stars in NGC 3603 owe their luminosity to the CNO cycle.

out how stars shine. This may seem like a singular achievement, but it was only one of the numerous reasons he was awarded a Nobel Prize in Physics.

Beginnings

Bethe was born in Strasbourg (then part of Germany) in 1906. It was a world awakening to new marvels such as radio, the airplane, radioactivity, and countless other discoveries and inventions. He was a child born to a mathematical curiosity. "As a boy I loved playing with numbers," Bethe says with a smile. While his father was a physiologist, the biological sciences did not interest Hans. "I never even considered it," he explains. "As I grew older I gradually turned to the physical sciences because I needed a place to apply the numbers I was playing with." After beginning his university studies in math, he switched to physics and quickly finished his degree. The year was 1926, and as University of Rochester physicist Robert Marshack once wrote, "Bethe's timing was impeccable."

In the 1920s, the new field of quantum mechanics was starting to mature. This strange and highly mathematical theory was developed to describe the world of atoms and electrons. During the previous two decades, physicists such as Niels Bohr and Albert Einstein had struggled to make sense of experiments probing distances a billionth of a meter and smaller. The world behaves very differently at that level compared with what we experience directly. Particles lose their identity, becoming ghostly clouds of probability. Uncertainty becomes a physical principle.

Despite the intellectual vertigo, by the 1920s physicists Werner Heisenberg, Erwin Schrödinger, and others developed the conceptual tools needed to scrutinize the atomic world. Their quantum mechanics now stands as one of humanity's greatest intellectual accomplishments. Bethe, who has been compared with a battleship for his single-minded determination in plowing though problems, stepped into the world of physics ready to take on the new tools of quantum mechanics.

The Move to America

"I worked in nuclear physics because of Hitler," Bethe tells me as an introduction to his work on stellar fusion. After finishing his Ph.D., Bethe wrote a number of insightful papers on the behavior of electrons in metals. The reputation he gained from this work soon proved invaluable. Bethe's mother was Jewish. That made him a target of the Nazi's growing political power. "The Germans were crazy," he recalls. The Nazis were determined to keep Jews out of university positions, and by 1933 Bethe saw the writing on the wall. He left for England, taking a position at the University of Manchester. There he was reunited with Rudolf Peierls, an old friend and fellow German refugee scientist. Peierls convinced Bethe that applying quantum mechanics to the subatomic or "nuclear" realm was the next great frontier.

"As a boy I loved playing with numbers."

In the early 1930s, physicists had only just recognized that the core of every atom was a dense knot of protons (having positive electrical charge) and neutrons (which had no electrical charge). Nuclear physics was a discipline that combined the study of matter's fundamental structure with a demand for deep mathematical insight. Bethe had found his love. Along with Peierls, he developed a theory of a simple nucleus, the deuteron — a form of hydrogen containing one proton and one neutron.

Bethe's work with Peierls was part of a lifetime of collaborative research. James Applegate, a Columbia University astrophysicist who worked with Bethe as a graduate student in the late 1970s, remembers his style. "When I started working with Bethe I was just this 23-year-old kid," says Applegate. "And yet from the first moment, Bethe took me seriously. All that mattered to him was the quality of ideas."

Applegate also recalls Bethe's classic theoretical physicist sensibilities when it came to dealing with certain day-to-day realities. "Opening the milk cartons each day in the cafeteria used to give him a lot of problems," says Applegate. "I hated seeing him wrestling so vehemently with the little boxes so I made it my responsibility to open them."

Based on the strength of his efforts with Peierls, Bethe was offered a faculty position at Cornell University. Given the turmoil in Europe, the move made sense. In February 1935, Bethe landed in the United States, his rendezvous with the stars waiting just around the corner.

Bethe's arrival in the United States was part of a wave of European scientific emigration. The rise of Hitler's regime sent many of the world's best scientific minds across the Atlantic. Each spring, Bethe found himself in Washington, D.C., attending annual nuclear physics conferences alongside fellow European luminaries such as George Gamow and Edward Teller (as well as their American counterparts). "It was at one of these meetings in 1938 that Teller and Gamow wanted to discuss nuclear physics and stars," recalls Bethe. Amazing as it may seem, this man who was about to reveal the secrets of star power had never really given the problem much thought before the late 1930s. "Astronomy and physics were much more separated then compared to now," says Bethe. "I knew some astronomers at Cornell, but we were miles away from each other in terms of our interests. I had not thought much about stars either as a child or as a young man."

Solving the Stars

Bethe and his colleagues at the 1938 meeting were taking on one of humanity's oldest questions: What makes stars shine? At the time, science had progressed to the point where it could, at least, say what didn't make them shine. The advent of radioactive dating allowed geologists to estimate Earth's age at billions of years. Because the sun had to be as old as Earth, a simple calculation revealed that its abundant warmth and light could not be fueled by chemical burning, radioactive decay, or even gravitational contraction. These processes liberate energy too inefficiently to sustain the solar fire for so many eons. As quantum mechanics penetrated ever deeper into the heart of atomic phenomena, it became apparent that the nucleus was the place to search for a new kind of fuel. In the 1920s, the eminent British astrophysicist Sir Arthur Eddington argued that nuclear physics would solve the mystery of star power. But even Eddington could not explain how it happened.

To educate themselves on problems of stellar energy generation, the Washington workshop organizers asked Swedish astronomer Bengt Strömgren to lecture on the current state-of-the-art in observational stellar astrophysics. As Bethe later wrote in his Nobel Prize lecture, "The astrophysicists told us physicists what they knew about the internal constitution of stars. This was quite a lot." According to Bethe, Strömgren's lucid talk left the group with three key facts to deal with: First, stars are composed mainly of hydrogen, with smaller amounts of heavier elements. Second, the best estimate of the temperature at the sun's core was 19 million kelvins. Third, massive stars shine much brighter than their low-mass cousins.

Enrico Fermi (left) stands next to Bethe during some free time at Los Alamos in 1943.

AIP Emilio Segrè Visual Archives, photo by Emilio Segrè

Each fact was crucial for establishing a theory of how stars shine. The high temperatures were important because they allowed nuclear reactions to take place. Because atomic nuclei are made of protons and neutrons, the nuclei always hold positive charges. Getting them close enough to fuse requires overcoming their mutual electric repulsion. High temperatures translate into atomic nuclei moving at high velocity. If nuclei slam into one another hard enough, they can overcome the electric repulsion and fuse to form new, heavier elements.

In a fusion reaction, some of the mass in the original nuclei is converted into energy (via Einstein's famous equation $E = mc^2$). The reaction is a little like slamming four golf balls together to form a baseball, releasing energy in the process. The liberated energy could, in theory, power a star. Because hydrogen (whose nucleus is a single proton) was the most abundant element, it had to be the principal fusion fuel available to stars.

German physicist Carl-Friedrich von Weizsäcker had already imagined a chain of nuclear reactions using only hydrogen nuclei to power stars. By fusing four protons in a two-step process, von Weizsäcker could produce energy to power the star and make helium, the next heavier element. Just before the conference, Bethe and von Weizsäcker's student, Charles Critchfield, also studied this "proton-proton" chain. The work was promising, but the reactions were too slow and inefficient to power the luminous high-mass stars. As the conference closed, it was clear there had to be more to the story.

Bethe mulled over the problem during the long train ride home to upstate New York. There were many possible chain reactions using different combinations of elements, but which ones did nature choose? Bethe now approached the issue of stellar nuclear fusion with the meticulous, battleship-like determination that had become his trademark. Moving up the periodic table of elements, he examined each element in detail, asking if it could be an efficient actor in a chain reaction. "Some of the elements were unstable, some were too rare," he recounts. "I just kept going up to heavier nuclei examining all the possibilities."

Element number six, carbon, gave him what he needed. Using this stellar trace element, together with nitrogen and oxygen, Bethe was able to map out a complicated six-step cycle. Bethe's carbon-nitrogen-oxygen (CNO) chain of reactions took four protons and two electrons and, after a series of intermediate steps, turned them into a single helium nucleus. The pre-existing heavier elements acted to catalyze the process, speeding the chain along and adding to its energy generation.

Bethe found that his CNO cycle was incredibly sensitive to the temperature in the star's core. Turn the temperature up just a bit and the energy output went through the roof. The cores of massive stars are squeezed hard by the matter lying above them. Temperatures in these cores can be more than twice that in the sun. These higher temperatures were just what Bethe needed. With his newly discovered CNO cycle, Bethe had found a way to power even the most luminous and massive stars.

"I went to great lengths to connect the nuclear physics to what astronomers observe in the stars."

On September 7, 1938, just a couple of months after the Washington conference, the journal *Physical Review* received a manuscript from Bethe entitled "Energy Production in Stars." The paper was a tour de force, providing explicit details of all the important nuclear reactions as well as eliminating all others. Bethe also wanted to make sure the connection to astronomy was explicit. "I went to great lengths," he says, "to connect the nuclear physics to what astronomers observe in stars."

Bethe's ideas began to circulate, and soon he was invited to the Harvard College Observatory for a lecture and a chance to defend his theory. Henry Norris Russell, perhaps the most respected American astronomer of his time, heard of the invitation and traveled from his home in Princeton to attend the lecture. "Russell came to my talk and asked some very embarrassing questions," says Bethe ruefully. "My knowledge of astronomy was limited and some of these I could not answer." Whatever fumbling Bethe made in his responses did not affect Russell's ultimate opinion of the theory. "Russell became my prophet," says Bethe, laughing. "He went around telling people, 'Bethe has solved the problem!'"

While Bethe thought his CNO cycle could power all stars, astronomers now know that the pure proton-proton chain that he, von Weizsäcker, and Critchfield worked out is the primary energy source for low-temperature stars, such as the sun. The CNO cycle powers only more massive, luminous stars. Despite this modern perspective, Bethe's achievement stands as a high point in astrophysics. When the Nobel

The White House

Hans Bethe meets with President John F. Kennedy in the early 1960s.

Hubble Heritage Team (AURA/STScI/NASA)

Bethe currently studies supernovae, such as 1987A, whose remnant appears here.

Prize committee gave the award to Bethe in 1967 for a lifetime of achievement, it singled out his work on stellar fusion for special attention. In 1938, with the results still fresh, Bethe could be justifiably proud of his achievement. Little did he know that his cherished nuclear physics would soon be called upon for a far more ominous purpose.

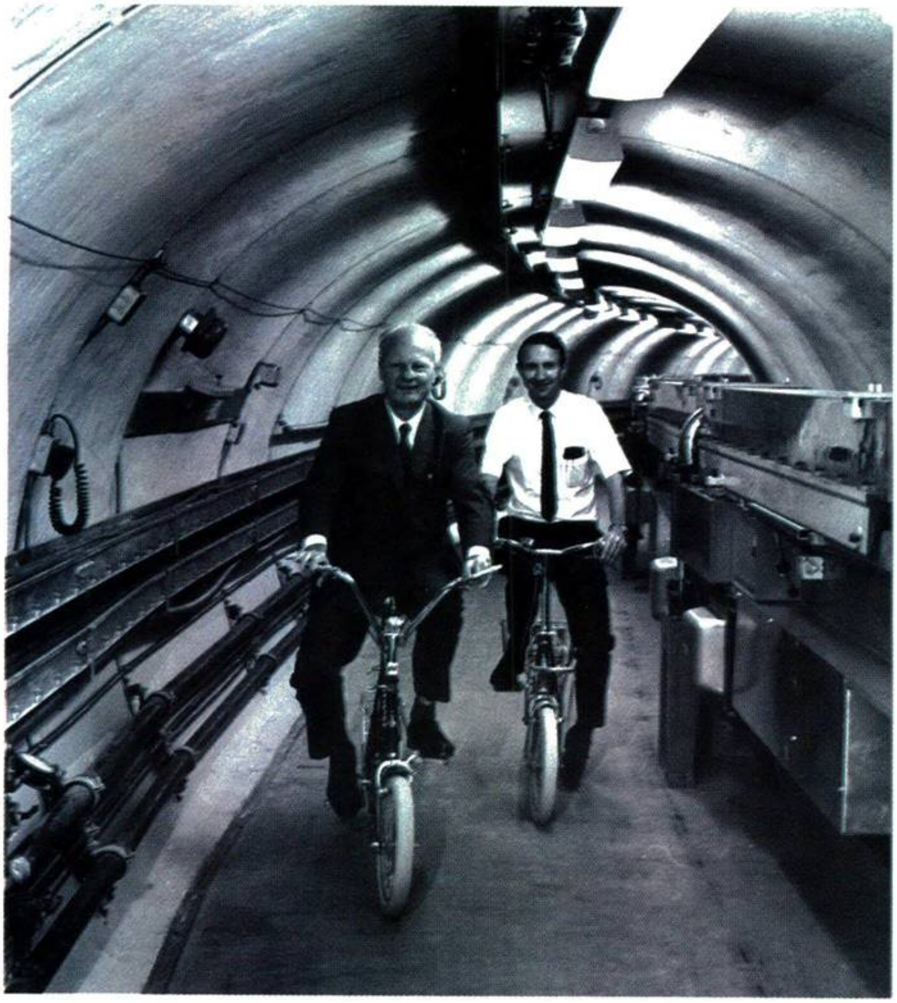
The Bomb

As Hitler's armies advanced across Europe, many of the world's greatest scientists recognized that a horrifying weapon lay at the heart of the atomic nucleus. While Bethe was working on fusion, other physicists were working on the reverse process: fission. In nuclear fission, a large atomic nucleus is split into smaller pieces, liberating vast amounts of energy.

The possibility of a fission bomb had been suggested as early as the mid-1930s, but many scientists were skeptical. But in 1942, Enrico Fermi built a small nuclear fission reactor at the University of Chicago. "After Fermi showed that fission reactions with uranium were possible, I believed a weapon could be built," says Bethe. In 1942 Bethe received a call from University of California-Berkeley physicist Robert Oppenheimer, asking him to join a new, highly secret project. A lab was being built in the high desert of New Mexico, at a place called Los Alamos. The rest, of course, is history.

Bethe became Director of the Theoretical Division at Los Alamos. He was one of the critical players in the development of the first atomic weapons. His work on the physics of shock waves allowed the project to construct high-explosive triggers that could activate the fission reactions and set off the bomb. In looking back on those years, Bethe feels that the work on the bomb was necessary and inevitable. Of the still controversial decision to drop the atomic weapons he helped build, Bethe has said, "I think it was necessary to drop one, but the second one could have easily been avoided. I think Japan would have capitulated anyway."

In the years that followed, Bethe would become a strong proponent for both arms control and peaceful uses of nuclear energy. When he speaks of the ban-the-bomb movement of the 1950s, he reflects, "Those people kept the



Sol Goldberg/Cornell University

Bethe (left) and Boyce McDaniel ride bicycles inside the Cornell Electron Storage Ring.

issue out in the public eye. That was vital." Not long ago, Bethe sent a letter to President Clinton arguing that in the post-Cold War world, no new creative research should be carried out on the design of further nuclear weapons.

Return to the Stars

After the war, Bethe returned to his beloved Cornell University, where he could occasionally be seen taking his students out to movies. He continued working on the fundamental structure of nuclear matter, but in time found himself back among the stars. Beginning in 1979, Bethe began studying another kind of explosion, the apocalyptic deaths of massive stars known as supernovae.

When a giant star runs out of nuclear fuel, its gravity pulls it down upon itself. The star collapses in a matter of hours. As gas rushes in toward the center, matter is squeezed to densities so high a thimbleful would weigh more than a skyscraper. The core is packed so tight it becomes, in essence, a giant atomic nucleus. At that point, with neutrons and protons rubbing shoulder to shoulder, no further compression is possible without the core imploding forever to become a black hole. If the star is not too massive, it will escape that fate. When the outer layers of the star fall onto the now ultra-hard nuclear core, they bounce back. A shock wave forms, turning infalling gas around and blowing the rest of the star apart.

For Bethe, a man of deep experience with both nuclear physics and powerful blast waves, supernova studies fit like a glove. For the last 20 years, the field has become his own, and he has pushed relentlessly at its frontiers.

"Hans has contributed significantly to our modern understanding of supernovae," says University of California, Santa Cruz, astrophysicist Stan Woosley. Woosley notes important works by Bethe that focused on how supernova blast waves form and evolve. "He has written perhaps a dozen influential papers on supernovae, including estimations of the energy of Supernova 1987A," says Woosley, himself a world expert in supernovae.

All of these works came from a man who is supposed to be retired. Like a scientific Energizer bunny, Bethe just keeps going and going. Pushing 100 years old, he has published more fundamental papers in the last 20 years than many hot, young astrophysics professors. His undiminished creativity is one reason why Bethe inspires a kind of awe in many scientists. When I asked University of Illinois astronomer James Kaler, an expert on stars, for his thoughts on Bethe, he responded with poetry: "Hans Bethe needs neither introductions nor accolades, neither awards nor prizes. He has the best and brightest of all trophies: the sun, whose radiance he helped explain, his work equally bright and illuminating."

Heading Home

After two hours of talking I fear I am taking too much of Bethe's time and begin to wind down the interview. It may be that I am the one getting tired; he doesn't seem winded in the least. We touch on a few more issues. Which work is he most proud of? "My work on stellar fusion," he replies. "It was such an old and profound question." What is the most compelling question facing physics? He answers quickly, "Unifying the four known forces of gravity, electromagnetism, and the strong and weak forces at work in the nucleus."

Finally, when I ask him what he thinks of science as a whole and his role in it, he pauses for a long moment. "There are qualitative laws of physics out there in the world," he begins. "The 300 years since Newton is a ridiculously small fraction of the 6,000 years of human history. The 6,000 years of recorded history is a ridiculously small fraction of the millions of years that the genus *Homo* has existed. And yet, here we are, the first to really understand the nature of those laws. I feel very fortunate to have been around at this moment in history." Perhaps, however, it is our moment in history that has been lucky to have Bethe. ■

University of Rochester astrophysicist Adam Frank is a member of Astronomy's *Editorial Advisory Board. His previous article was "Bursting the Bubbles" in April 2000.*

JMI *(www.jimsmobile.com)*

Are you the fastest gluer in the west?

JMI has a case to make. Plucking and gluing cubes is for the birds. If you can glue the cubes back in as fast as they fall out, we congratulate you. For those who can't, get a professional cut JMI case.

New LX90 Case

$249.95($14)

BEST FOAM IN THE INDUSTRY

This foam fits the Pelican 1650 case.

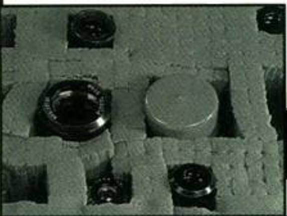
Custom Designed By JMI

Sleek & Compact, with Wheels

Does your case look like a bag of french fries?

Replace them with JMI die-cut foam for the LX90 and NexStar 8 $89.95 plus shipping.

Note: This foam fits the Pelican 1650 case. Inside measurements are 28-3/4" x 17-3/4" and you will reuse the top and bottom pads.



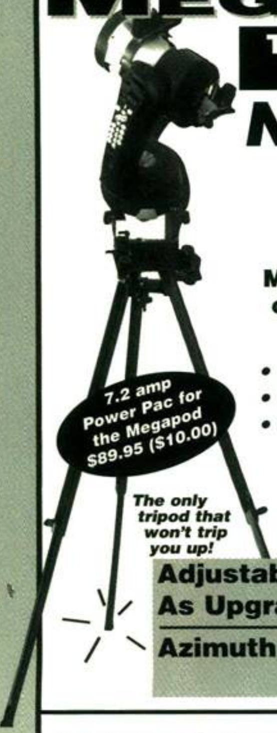
Nexstar 8 Case

$249.95($14)

- *Holds 4-6 eyepieces.*
- *Professional Die-Cut Foam Lining -Top & Bottom (No cubes to fall out).*
- *Compartment to hold eyepieces, hand controls, etc.*

Foam Lined Carrying Case	
ETX-125EC	**$129.95 ($8)**
NextStar 5	**$129.95 ($8)**
EXT-90, ETX-90EC	**$ 99.95 ($7)**

MEGAPOD



The Best Tripod just got better!

NEW LOW PRICE

$199 ($14)

Megapod has features other tripods owners only dream of . . .

- ***Flashing red lights***
- ***Polar alignment tube***
- ***Solid Steel***

7.2 amp Power Pac for the Megapod $89.95 ($10.00)

The only tripod that won't trip you up!

Piggy-Back Mounts	
EXT-90, ETX-90EC	**$59.95 ($6)**
EXT-125EC	**$74.95 ($6)**
NEXSTAR 5	**$69.95 ($5)**
NEXSTAR 4	**$59.95 ($5)**

Adjustable Azimuth As Upgrade Add $29.95

Azimuth Retro-Fit Kit $79($8)

Schmidt–Cassegrain Focuser

Manual version of *JMI's famous Zero–Image–Shift NGF–S focuser*

NGF–SE Manual Focuser **$169 ($7)**

NGF-S for **SCTs** - This special version of our **NGF** focusers fits directly on to 2" thread of Meade and Celestron 8"-14" Schmidt Cassegrain telescopes.

NGF-S w/built-in **MOTOFOCUS** **$269 ($7)**

"To put it bluntly, if there's a better line of commercial focusers made for imaging, I don't know about it."

–Dennis di Cicco
3/94 Sky & Telescope–

ZERO Image Shift Focuser

NGF-DX1 2" with 1.25" adapter (lifts 10lb.)	**$259.00**	($7)
NGF-DX2 2" with 1.25" adapter (lifts 8lb.)	**$199.00**	($7)
NGF-DX3 2" with 1.25" adapter (lifts 6lb.)	**$159.00**	($7)
NGF-mini2 1.25"	**$129.00**	($7)
NGF-mini3 1.25"	**$99.00**	($7)
DRO (digital focusing)	**$229.00**	($7)
DFC	**$69.95**	($5)
MOTOFOCUS when ordered with focuser	**$100.00**	(N/A)

Don't get stranded, focus your scope even after the batteries are dead.

New InstaFocus

for the ETX-90 and ETX-125
NexStar 5 & 8

NEW

Electric focus with manual overide

Introductory Special $99.95($6)

Prices are subject to change

Breakthrough Integrated Digital Focus Counter with Heavy Duty MOTOFOCUS. Great for CCD work. 999 on display = 10 turns. Fits all Meade and Celestron SCTs and MAKs, 7" through 14" MOTOFOCUS with DFC **$179.90**

MOTODEC for most popular Telescopes as low as . . . **$99.95 ($6)**

Our after-market computers fit over 100 Models of Telescopes

EZAlign

Polar alignment scope

- *Fits fork mounted Telescopes*
- *Easy to install, No Drilling*
- *No Need to Remove for Transport*
- *Illuminated reticle included*

$230.00 ($6)

MEDIUM SIZE
UNIVERSAL WHEELEY BARS
Move your scope with ease,level, lock the wheels, fits most Meade 2080/2120, Star finder 6/8/10, most SCT's up to Ultima 11, adjustable tip-to-tip distance 31 to 41inches.
TPWUMED **$169.95 ($15)**

LARGE SIZE
UNIVERSAL WHEELEY BARS
For Meade Giant Field Tripod, Meade LXD700/750 and Celestron CI-700
TPWULG **$229.95 ($25)**

NGT-18 Split-ring Equatorial 18" f/4.5 ***$12,900***

NGT-12.5 Split-ring Equatorial 12.5" f/4.5 ***$4,900***

NGT-6 Split-ring Equatorial 6" f/5 ***$1199***

SPECIAL OFFER
FREE TRIPOD with NGT-6 Order
Expires 10-01-01

Call Now
1-800-247-0304
Visa & Mastercard accepted.

(www.jimsmobile.com)

Jim's Mobile Inc. • 810 Quail St. Unit E • Lakewood, CO 80215 • Orders: 800-247-0304 • Info: 303-233-5353 • Fax: 303-233-5359

KEEPERS OF THE NIGHT

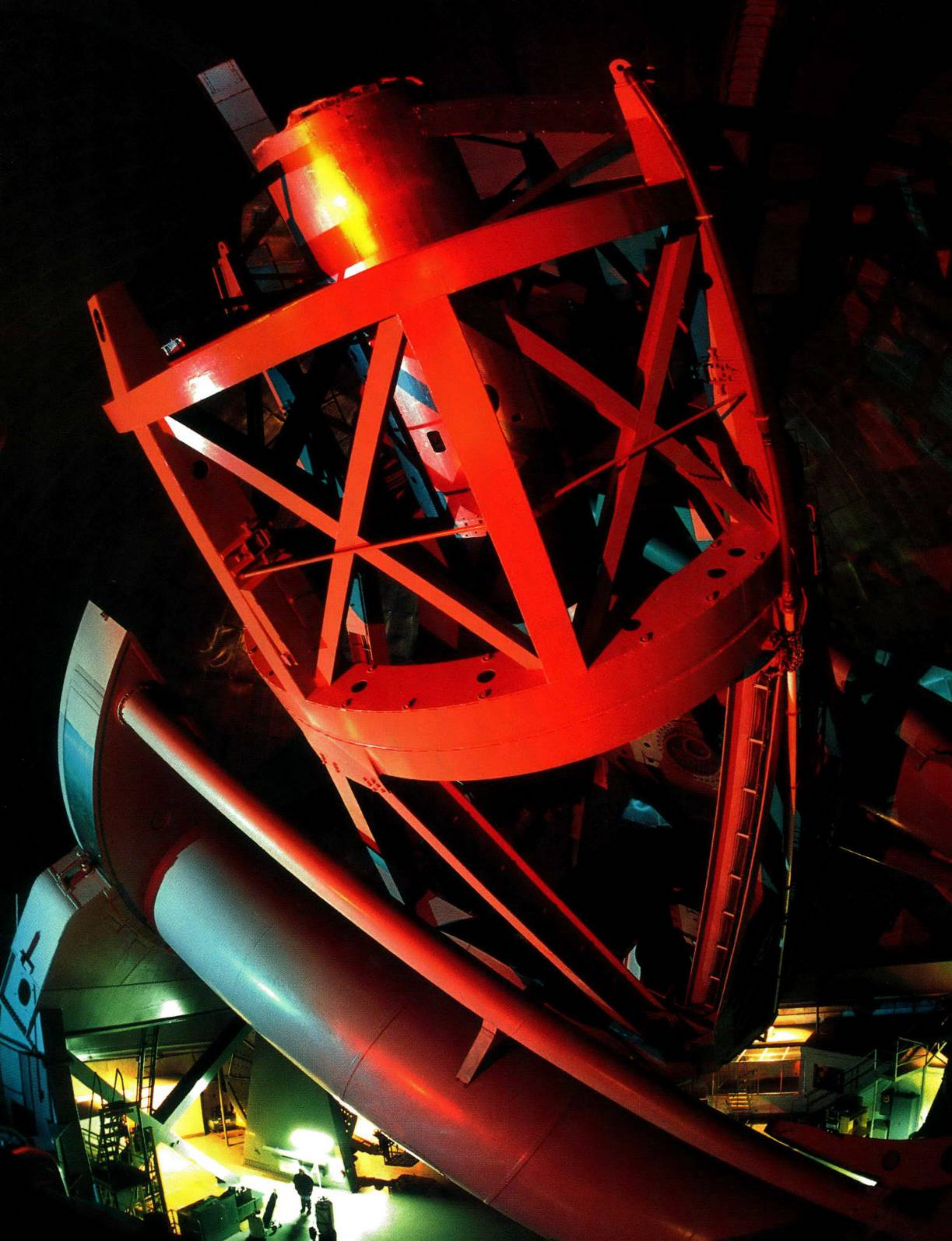
A behind-the-scenes look at the people who keep a 55-year-old telescope from falling off the cutting edge.

Text by Robert Naeye
Photos by Raleigh Souther

"We could run this mountain a hell of a lot better if the astronomers wouldn't come up here."

At the time that Byron Hill, the first superintendent of Palomar Observatory, uttered these words, Palomar's 200-inch Hale Telescope was the most powerful scope in the world. The brainchild of astronomer-entrepreneur George Ellery Hale, and the product of Depression-era technology, the 200-inch telescope had twice the diameter of any other telescope. And it would reign supreme as the world's premier ground-based telescope from 1948 until the 10-meter (394-inch) Keck I Telescope on Mauna Kea began operation in 1993.

On nearly every clear night since 1948, astronomers have probed the deepest reaches of the cosmos with the 200-inch Hale Telescope.



Into the mid 1980s, astronomers often rode solo up an elevator to the prime-focus cage, a 6-foot-wide circular prison cell perched 10 stories above the great mirror. These hearty souls would sometimes brave bone-chilling temperatures and wind, endure hours without food and water, and suffer the "agony of the bladder" — often just to expose a single photographic plate.

Much has changed in the last 20 years. New technologies have revolutionized not only what astronomers can achieve, but the very way they practice their craft. Armed with modern CCDs 100 times more efficient at capturing light than film, and high-tech spectrographs capable of simultaneously recording the spectra of hundreds of galaxies, astronomers can accomplish in a single night what once took years. And because the new generation of CCDs and spectrographs can relay data instantaneously to computers, those lonely 12-hour vigils in the prime focus cage have been replaced by the creature comforts of heated control rooms and a bathroom just 20 feet away.

Since Palomar's opening more than 50 years ago, one rule hasn't changed: Astronomers aren't allowed to operate the telescope. Rather, it's the telescope operators (or night assistants, as they're called on the mountain) who are trusted with guiding the instrument on its nightly flights through the universe.

Accompanied by regular *Astronomy* photographer Raleigh Souther, I set out on a weekend in early February 2001 to explore the evolving relationship between the astronomers who use the Hale Telescope and the support staff who keep it running, from telescope operators to the resident chef.

ROAD TO PALOMAR

The steep, winding road to Palomar affords occasional but spectacular views of the valley below. Nearing the observatory at an elevation of 5,600 feet, we passed through rustic forests. Unlike the domes of northern California's Lick Observatory, which can be seen from 50 miles away, the mountain hides Palomar's impressive domes until you're almost there.

Upon arriving, I discovered my home for the weekend — a room in the southeast corner of the first floor of the Monastery — the place where visiting astronomers eat, drink, sleep, share the excitement of their latest discoveries, and commiserate over bad weather. Looking out the window to the surrounding conifer forest and meadow, the observatory grounds feel like a secluded resort. That is, until you notice the house rules posted on the door: "Please avoid disturbing others who may be sleeping. . . Take your shower after 1 P.M. Let dark shades up quietly. Walk softly. Avoid conversation. Close doors gently. Thank you." Clearly, this is a place for astronomers.

NEW TOYS ON THE MOUNTAIN

That evening, we joined Jet Propulsion Laboratory (JPL) astronomers Rich Terrile and Christophe Dumas in the dining room for a hearty meal prepared by observatory chef Dipali Cross (who lets no one go hungry on Palomar Mountain). Tonight, Terrile and Dumas were aiming the 200-inch at Europa, the jovian moon suspected of harboring liquid water beneath its icy surface. Last night, their hopes had been shut down by poor weather. They hoped tonight would bring better results.

Tranquil environs bring Palomar astronomers down to Earth after long nights of observing.

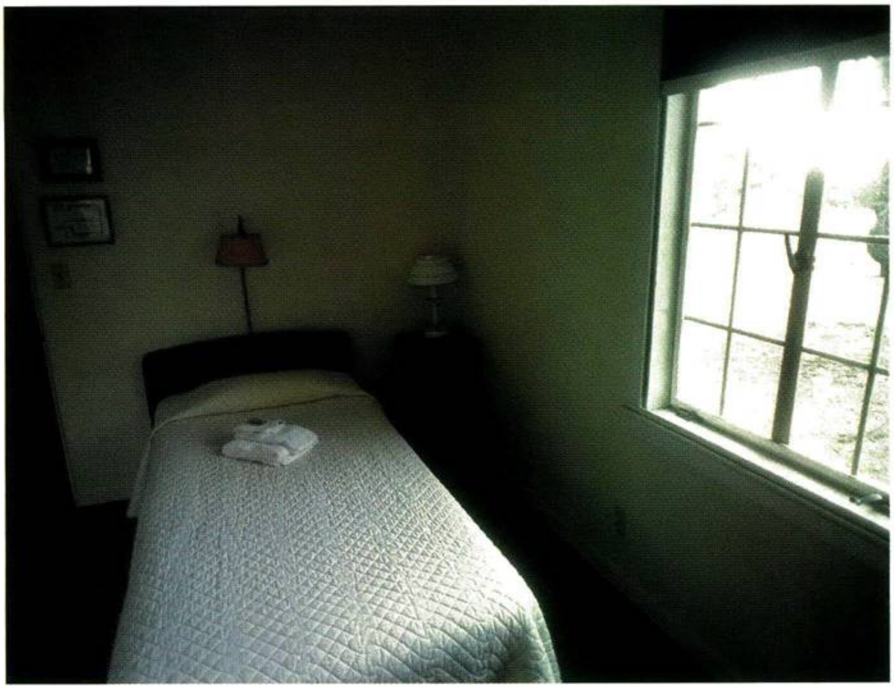
Terrile and Dumas are hunting for evidence of salts, sulfates, and ices with mid-infrared spectra of Europa while using the newest toy on the mountain — adaptive optics. The atmospheric seeing over Palomar Mountain is usually fair to good. But AO, as everyone on the mountain calls it, allows astronomers to compensate for blurring atmospheric turbulence by using bright guide stars and an active deformable mirror. Palomar's AO unit is mated to a mid-infrared camera and spectrometer built at Cornell University called PHARO (Palomar High Angular Resolution Observer). Because PHARO doesn't need to withstand the rigors of space, it is more sensitive than the infrared spectrometer aboard NASA's Galileo Jupiter orbiter. Thanks to PHARO and AO, Terrile and Dumas could realistically expect to achieve higher spectral resolution from a range of 445 million miles than Galileo can achieve from a mere 445 miles.

WHO'S IN CONTROL?

Darkness had already fallen on the mountain as we drove the quarter mile to the small parking lot at the base of the Hale Telescope dome. Yet, the graceful curved lines of the 7-story-high dome still radiated with a powerful elegance. In the 200-inch control room, we rendezvoused with Terrile and Dumas, and met veteran Palomar night assistants Jean Mueller and Rick Burruss.

"I love observing at Palomar. These mechanical systems work like a dream," says Terrile, a leading scientist associated with the Voyager flybys of the outer planets and discoverer of five moons, including Saturn's 17th moon Atlas. "And the people who run this place are highly competent. Many times when you're observing, things don't go absolutely smoothly; you're solving problems all the time. The one thing you learn is that if something goes bad, you don't get upset. My advisor Jim Westphal used to say, 'You can get upset about it and fix it, or you can just fix it.' The staff here is well-known for fixing it."

Besides operating the scope, night assistants like Mueller make a ritual of going outside every hour or so to monitor the weather for rain, snow, fog, high winds, or even ash from nearby forest fires that could damage the precious 200-inch mirror. Tonight would require all of Mueller's years of experience on the mountain because the forecast called for snow.



With black shades standard, Monastery accommodations ensure sound sleep well past noon.

PULLING RANK

Mueller, who always wears a smile, takes seriously her responsibility for 530 tons of the best technology the 1930s had to offer. "It was a real thrill meeting Rich Terrile last night; he was one of my heroes from the Voyager days," she recalls. "But I said to him, 'It's an honor to meet you, but now I'm going to have to shut the telescope down because of humidity.' " At Palomar, night assistants hold rank over visiting astronomers.

Mueller's background is hardly what I expected for someone entrusted with safeguarding a national treasure from those astronomers who might accidentally bring it harm. After earning an undergraduate degree in political science and a master's degree in library science, Mueller worked 10 years as a librarian at the University of Southern California (USC). She even attended law school for a brief period. But after taking Astronomy 101 at Rio Hondo College, and two astronomy courses at USC, astronomy became her life.

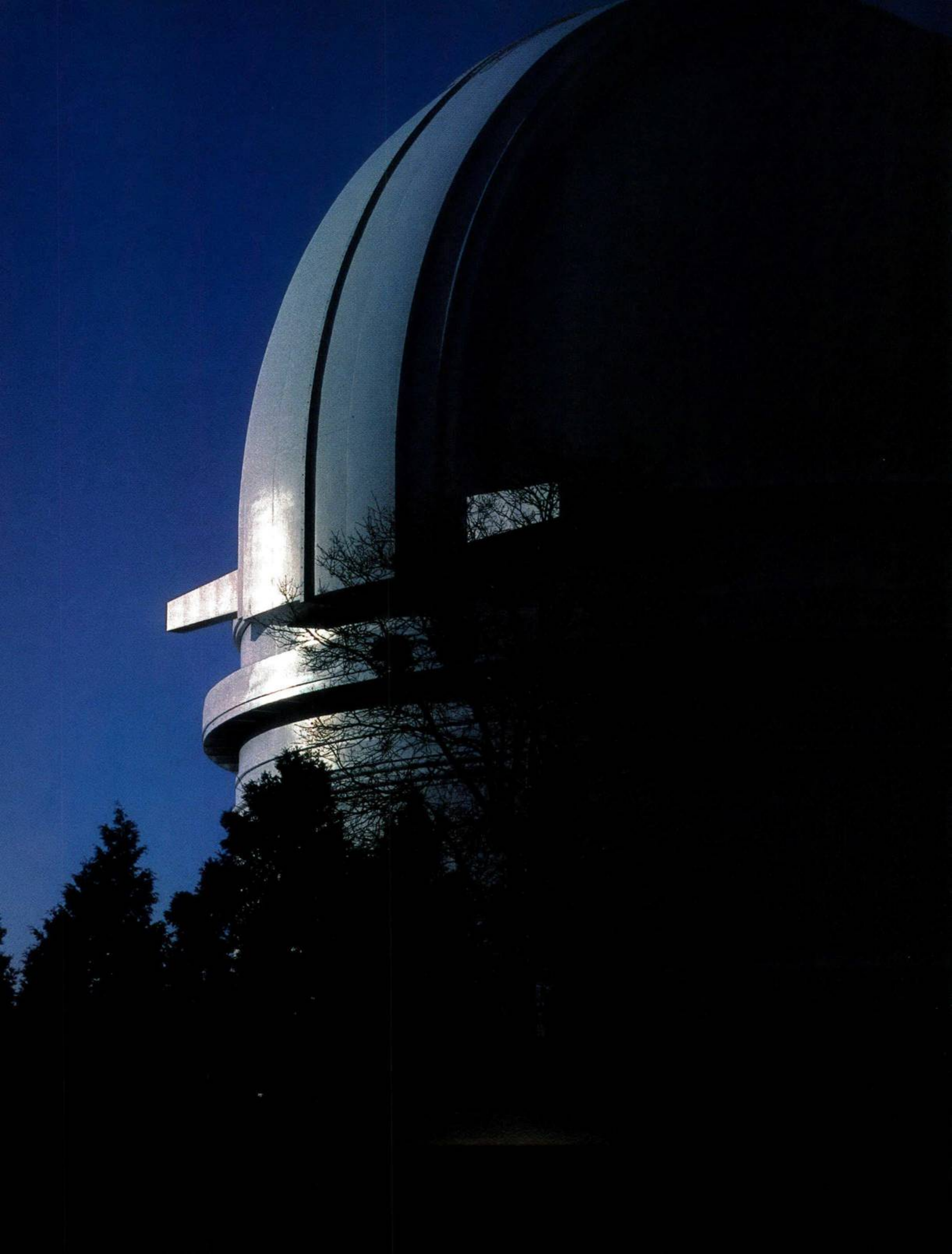
She landed a job as a night assistant at Mt. Wilson in 1983 and moved to Palomar in 1985 when Mt. Wilson started to scale back its operations. She has spent most of her Palomar career exposing photographic plates with the 48-inch Schmidt-type Oschin Telescope for the second Palomar Sky Survey. Over the years, Mueller has discovered seven near-Earth asteroids and 107 supernovae on the survey plates. But, she points out, "There's no better adrenaline rush than finding a comet." In all, 15 comets bear the name Mueller.

Along with Palomar's other two night assistants, Mueller works a 10–4 schedule, meaning 10 days on, 4 days off. Those 10 "on" days usually translate to 12.5-hour shifts. "It's a long 10 days," she says, "but I get a charge out of everything." She even smiles as she describes some of her more mundane duties, such as plowing snow and stripping the thin aluminum layer when the giant mirror needs recoating.

Like many of the Palomar staff, Mueller lives on the mountain in one of 13 cottages owned by Caltech, which is in overall charge of the observatory. "The houses are small, but comfortable," says Mueller. "When I grew up in Los Angeles, I never dreamed I'd live in the mountains. This is heaven. But there are drawbacks. Your social life plummets when you're in an isolated setting like this."

JACK-OF-ALL-TRADES

The previous night was Mueller's first experience running AO. "AO is very new to everybody," she says. Fortunately, Rick Burruss was around that evening to lend a helping hand. Burruss was formerly a night assistant for



the 60-inch telescope and later the 200-inch. During his spare time, Burruss studied Palomar's instruments and developed new software to run the Hale Telescope more efficiently. "The more you know the instruments, the more smoothly things go. We're here to serve the observer," says Burruss.

After five years with the observatory, Burruss was promoted to his current position as Palomar's unofficial Jack-of-all-trades. JPL engineers developed Palomar's AO system. And for more than a year they stayed at Palomar to test the instrument and train the observatory staff. But now that the testing and training have been completed, they've turned AO over to Burruss, who, in turn, is training Mueller and the other night assistants.

Burruss is responsible for helping astronomers learn to operate all of Palomar's eight primary instruments; he's also the troubleshooter when something goes awry. Burruss earned his bachelor's degree in astronomy from San Diego State University in 1995. After college, he worked as a manager at United Parcel Service until one day a family member spotted an ad in a local newspaper. Palomar Observatory was looking for a night assistant. "The night assistant job just happened to open up when I was at a crossroads in my life," he says, "and I decided to come this way." He applied, landed the job, and the rest is history.

Facing Page: The majestic curves of the 1,000-ton Hale dome slice the twilight mountain sky. Left: Palomar night assistant Jean Mueller takes control. Center: Palomar Jack-of-all-trades Rick Burruss poses in the east support arm of the Hale Telescope. Right: Burruss inspects the telescope optics from coudé alley, near the main control room.

THE POWER OF AO

Back in the control room, the beauty of AO quickly became apparent. "Look at Europa — it looks like a potato," says Dumas. But after Mueller punched a button, the big potato on the monitor was instantly transformed from a fuzzy blur into a crisp white dot. "It looks like we've got a great AO lock," says Burruss.

Even a veteran astronomer like Terrile can hardly believe the power of AO. "It's unheard of what we're doing with AO," he says. "You can dial in any atmospheric seeing you want. We thought ground-based astronomy had reached its pinnacle. Everyone assumed the next level was space-based astronomy. This incredible leap in our understanding of the atmosphere is like black magic. It's a new dawn, a second life for ground-based astronomy. But sometimes it's frustrating because it adds another layer of complication. When something goes wrong, it's 'wham,' you're suddenly back to where you were two years ago."

ROMANCE LOST AND FOUND

Modern-day observing is remarkably efficient, but I found it about as enthralling as driving across central Nebraska. There was no hint of a starry dome overhead, no galaxies seeming to hover above the giant mirror as viewed from the prime focus cage.

Even Terrile conceded that modern technology has taken some of the romance out of observing. But he added, "My first decade in astronomy was spent up on mountaintops shivering in the night. Now, we no longer freeze to death. And imagine being in the prime focus cage and holding your head at an awkward angle for hours. Your neck hurt like hell."

After the observers closed up shop, we ventured into the dome. Mueller flicked on the light switches and we caught our first glimpse of the 200-inch in full force.

The telescope is certainly majestic, though not necessarily beautiful: It's a maze of steel and concrete, and like many of the fixtures inside the dome, the girders were painted a drab battleship gray. Like many folks, I am more impressed by what it can do than by how it looks. Still, one can't help but be awed by a behemoth weighing twice as much as the Statue of Liberty, yet capable of tracking Earth's rotation with a 59-year-old softball-sized motor, running on 1⁄12-horsepower.

This is the telescope that doubled the size of the observable universe, helped astronomers piece together the story of stellar evolution, and extended humanity's gaze outward beyond the local galactic neighborhood into the realm of the quasars.

DAY SHIFTERS

With several inches of freshly fallen snow lacing the nearby evergreens and road, we entered the dome the next morning to find Dave Tennant, an instrument technician, and Steve Kunsman, a senior electronics technician, busily detaching PHARO from the telescope so they could install another instrument for the next observer.

Caltech astronomer Lynne Hillenbrand was scheduled to observe young stars with SpectroCam-10 (a Cornell-built infrared imager and spectrometer) for the next three nights. As instrument technicians, it was Tennant and Kunsman's responsibility to install SpectroCam-10 by the time Hillenbrand arrived around 2 P.M.

I was worried about disturbing Tennant and Kunsman as they went about their business, but they quickly put me at ease. Neither was bashful when it came to spinning yarns about his job, his background, or the history of Palomar. "Life here is like a soap opera," said Tennant. "But instead of *As the World Turns*, it's *As the Dome Turns.*"

After detaching the various components of PHARO from the telescope and the cage, Tennant and Kunsman used a hydraulic lift and an elevator to lower the components to the floor. The engineers who designed all this heavy equipment made sure that Palomar day shifters like Tennant and Kunsman wouldn't break their backs lifting and hauling the gear. Almost every component was on wheels, so each could be pushed to a freight elevator to take it down to PHARO's storage room in the dome's dreary, cavernous basement.

After PHARO was safely tucked away, we walked down the hallway to a wooden door marked "Cornell Room." Inside was a metallic blue cylinder — SpectroCam-10. Using a long, thin hose, Tennant and Kunsman connected SpectroCam-10's external tank to a tank of liquid helium. In order to detect faint infrared sources from deep space, SC-10 operates at –454° Fahrenheit, a little more than 5° above absolute zero. The liquid helium acts as the refrigerant to keep the instrument's own electronics from swamping the faint heat energy (in the form of infrared light) of distant cosmic sources. Kunsman warned me it wouldn't be a good idea to touch any of the wires where the liquid was flowing from one tank to the other. "This is a dangerous operation," he said. "We just make it look routine."

RAIN OR SHINE

Today marked Kunsman's four-year anniversary at Palomar. Following a four-year stint in the early 1970s as a communications specialist for the U.S. Air Force, he spent 25 years repairing TVs and VCRs. Like Burruss, he came to Palomar after seeing an ad in the newspaper. And he's glad he did. "I've never gotten tired of it. And it never gets old," says Kunsman.

Tennant has been at Palomar for 21 years. Like Kunsman, he has a background in electronics. He served in the U.S. Army from 1955 to 1958, and later worked 15 years at the Scripps Institution for Oceanography in San Diego.

Kunsman and Tennant do more than change instruments. "We can work with electronics, computers, and hydraulics. We can do a little bit of everything. We even get into septic tanks," says Tennant. But he also says his job hasn't really changed much over the years, despite new technologies. "The installation procedures haven't changed, it's just that the instruments have gotten a lot better. We still have to worry about making good electrical connections and we still have to worry about static electricity."

When they finished loading the electronics package for the SC-10 and making connections to the control room. I wondered why they had been working so feverishly to set up for Hillenbrand despite the probability of more bad weather tonight. "The weather up here can look bleak, but you never know. So no matter what the forecast is, we do our work every day," said Kunsman.

PALOMAR'S GOLDEN RULE

At 2 P.M., Lynne Hillenbrand, accompanied by Caltech postdoc John Carpenter and graduate student Stan Metchev, entered the dome. They were in full compliance with Palomar's Golden Rule: "If you're on the schedule, be at the telescope. If you're at the telescope, be on schedule."

Hillenbrand told us that the latest reports called for more snow and that there was virtually no chance her team would be able to observe that night. Kunsman joked, "Here we are knocking ourselves out, and Lynne's not at all optimistic." I asked Hillenbrand why she even bothered to drive the three hours from Pasadena. "I've never

When the weather is good and all systems are go, astronomers huddle in the Hale control room, discussing the latest data over a background of Mozart and Metallica.

GEORGE ELLERY HALE

For sheer entrepreneurial chutzpah, George Ellery Hale (1868–1938) has to rank among the greatest astronomers of all time. Four times he built the world's largest telescope. He was also a cofounder of the California Institute of Technology and of the *Astrophysical Journal*.

Apart from being a great solar astronomer, Hale had a unique talent for separating wealthy men from their money. In the 1890s, he persuaded the Chicago transportation tycoon Charles Tyson Yerkes to donate $500,000 to build Yerkes Observatory and its fabled 40-inch refractor. And in the early 1900s, Hale coaxed millions out of Andrew Carnegie and later Los Angeles businessman John Hooker to build the 60- and 100-inch Mt. Wilson reflectors.

In the 1920s, he commenced work on his crowning achievement. By the late 1920s, Hale had secured $6 million from the Rockefeller Foundation to construct a 200-inch telescope. Hale, who was later plagued by bouts of psychosis, did not live to see the completion of the telescope that rightfully bears his name.

Senior electronics technician Steve Kunsman makes sure that the proper scientific payload is loaded on the telescope before visiting astronomers descend on the mountain.

observed with SpectroCam-10 before," she said. "We wanted to come up and learn how it works."

As it was snowing by the time we returned to the dome after dinner, it was obvious that there would be no chance for observing. But this would be my opportunity to find out what astronomers do on cloudy nights. The answer? They surf the web. "When we get bored, we check the weather at other observatories," said Hillenbrand. Echoing Rich Terrile the night before, she added, "Weather is the one thing in this business that there is no use getting uptight about. Hikes through the snow around here are great. So when the weather is bad, all is not lost." In the meantime, Mueller was out plowing the roads.

DEDICATED UNTIL THE END

Later in the evening, Mueller gave me a tour of the basement beneath the dome. It may be dreary and cold, but it exudes history and tradition. We visited the sole surviving dark room, the machine shop, the kitchen, the library, and the room where all the negatives and transparencies are stored from the two Palomar Sky Surveys. But for me, the highlight was the billiard room, where the astronomers and staff of yesteryear — Edwin Hubble, Fritz Zwicky, Walter Baade, Milton Humason, Allan Sandage, and others — once passed the time on cloudy nights, sometimes wagering significant amounts of money. "Who's the best pool player on the mountain?" I asked. To my disappointment, Mueller replied, "Astronomers are usually working on cloudy nights, they don't play much pool anymore." In the old days, she explained, astronomers took their data back to their home institution to reduce and analyze it. But now, they can log onto their computers from Palomar, so they spend cloudy nights crunching data.

Despite the snow on the dome, Burruss stuck around. "Lynne hasn't used SpectroCam-10 before, so my primary responsibility tonight is to help her get up to speed," he said. I asked him whether astronomers sometimes get upset with night assistants if they close the dome on account of weather. "When I started here five years ago, I expected astronomers to be more frustrated with the weather," he says. "But it isn't like that. Observers want as much time as they can get. And telescope operators want to give them as much time as they can. We have to follow the rules, but I haven't experienced animosity or friction because of it."

Though they may deny their roles as unsung heroes, the hard work of Palomar Observatory's resident support staff allows the visiting astronomers to achieve success, and on occasion, glory. And while Byron Hill's attitude no longer holds sway on Palomar Mountain, one thing remains true: No matter how impressive the telescope, the mirror, the beautiful domes and residence halls, or the fancy gadgets and gizmos, it's the people who make this place special. ▣

Robert Naeye is editor of Mercury, *a bimonthly magazine published by the Astronomical Society of the Pacific. He is the author of* Signals from Space: The Chandra X-ray Observatory *(Turnstone Publishing Group, 2000), now available at Amazon.com.*

VIEW OVER 13,000 PRODUCT DESCRIPTIONS ONLINE!

ORDER ONLINE

www.focuscamera.com

4419-21 13TH AVENUE, BROOKLYN, NEW YORK 11219

TOLL FREE FAX: **800-TO-FOCUS**
OVERSEAS FAX: **718-437-8811**

888-221-0828

N.Y. STATE & OVERSEAS:
718-437-8810

MEADE ADVANCED PRODUCTS

MAKSUTOV-CASSEGRAINS

ETX SCOPES

Exquisite, Diffraction-Limited Imaging in an advanced, ultra portable telescope system!

ETX-90EC Includes:
w/Dual-Axis Drive,
8x21 Erect-Image Viewfinder
& 26mm Plossl

ETX- 125EC Includes:
Dual-Axis Drive,
8x25 Right-Angle Viewfinder
& 26mm Plossl

Optional #497 Autostar controller with GO TO capability **$149**

ETX 60 AT 60mm (2.4"), 350mm f/5.8 w/tripod	$275
ETX 70 AT 70mm (2.8") 350mm f/5 w/tripod	$299
ETX 90EC 1250mm f/13.8	$595
ETX 125EC 1900mm f/15	$895
LX-50 7" f/15 w/Std Equatorial Wedge	$1,795
LX-200 7" f/15 w/Heavy Duty Fork Mount	$2,795
#883 Deluxe ETX Field Tripod (90/125)	199.00
#64 Photo Adapter (90/125)	34.95
#825 8x25 Right-Angle Viewfinder (90)	49.95
#880 Equatorial Table Tripod (90)	29.95
#881 Equatorial Table Tripod (125)	59.95
#932 45° Erecting Prism (90/125)	49.95
#1244 Electric Focuser (90)	119.95
#1247 Electric Focuser (125)	119.95
#773, #774, #775 Hard Case for ETX	CALL

SCHMIDT-CASSEGRAINS

In virtually every country in the world where serious telescopes are sold, more Meade LX-200's are sold than all competing models combined.

Standard-equipment includes:

- Superb optics
- Automatic GO TO capability
- LX-200 High-Precision Pointing
- Permanently-Programmable Smart Drive
- 9-Speed Dual-Axis Electronics
- Field operation

NEW! **LX-90 8"** f/10	$1695
LX-50 8" f/10	$1,395
LX-10 8" Deluxe w/software, 8x50 vwfndr	$1,149
LXD 300 SERIES 203 8" f/10	$795
LXD 500 SERIES 203 8" f/10	$895
LX-200 8"	$2,295
LX-200 10"	$2,695
LX-200 12"	$3,995
LX-200 16"	CALL
LX-200SC 12" f/2.2 Schmidt-Camera	CALL
Magellan I #2014 f/LX-10	375
Magellan II #2024 f/LX-50	495

STARFINDERS

Dobsonian Deluxe Package Add $49.95

SPECIAL EYEPIECE OFFER! At time you order any Meade Equatorial, get a 9.7mm Series 4000 Plossl **for only $29.95!**

	Dobsonian	Equatorial
6" f/8 w/26mm Plossl	$349.95	$499.95
8" f/6 w/26mm Plossl	$449.95	$599.95
10" f/4.5 w/26mm Plossl	$599.95	$699.95
12" f/4.8 w/26mm Plossl	$895.95	-
16" f/4.5 w/26mm Plossl	$1,195	$2,695

Magellan I #2010 f/Dobsonians	295
Magellan I #2011 f/Equatorial 6", 8", 10"	295
Magellan I #2012 f/Equatorial 16"	295
Magellan II #2018 f/Equatorial 6", 8", 10"	495
Magellan II #2019 f/Equatorial 16"	595

PICTOR CCD IMAGERS
416-XTE & 1616-XTE

With New Kodak Blue-sensitive CCD Chip

For the beginner, or for the most advanced observer, the real CCD revolution is here!

201-XT Autoguider/Imager	395
208-XT Autoguider/Imager	495
216-XT Autoguider/Imager	695
416-XTE Autoguider/Imager	1,995
1616-XTE Autoguider/Imager	6,495
Off Axis Guider f/CCD	89.95
616 Color Filter System f/416, 1616-XT	695
616A Color Filter System f/216	695
520 Electronic Relay f/201, 208, 216, 416, 1616	94.95
541 AC Adapter f/201, 208, 216	36.95
542 AC Adapter f/416, 1616	94.95

EYEPIECES

MODIFIED APOCHROMATIC

9, 12, 25, 40mm 1.25"	37.95	9, 12, 25, 40mm .96"	29.95

PLOSSL SERIES 3000

5, 6.7, 9.5, 16, 25mm 1.25"	49.95	40mm 1.25"	79.95

SUPER PLOSSL SERIES 4000

6.4, 9.7, 12.4, 15, 20, 26mm 1.25"			79.95
32, 40mm 1.25"	99.95	56mm 2"	199.95

PLOSSL SERIES 4000 SUPER WIDE ANGLE

13.8mm 1.25"	139.95	18mm 1.25"	149.95
24.5mm 1.25"	179.95	40mm 2"	299.95
32mm 2"			239.95

PLOSSL SERIES 4000 ULTRA WIDE ANGLE

4.7mm 1.25"	169.95	8.8mm 1.25"/2"	239.95
6.7mm 1.25"	199.95	14mm 1.25"/2"	299.95

ILLUMINATED RETICLE EYEPIECE SYSTEMS

	Wireless	w/Cord
Plossl 9mm 1.25"	149.95	129.95
MA 12mm 1.25"	99.95	79.95
MA 12mm Astrometric 1.25"		119.95
Plossl 25mm CCD Framing Ocular 1.25"		129.95

BARLOWS

#122 2x Telenegative 1.25"	44.95
#126 2x Short Focus 1.25"	44.95
#127 2x-3x Variable 1.25"	56.95
#134 Achromatic .96"	44.95
#140 2x Apochromatic 1.25"	74.95

ED APO REFRACTORS

300 SERIES

102 Achromatic 4" f/9	$595

500 SERIES

102 Apochromatic 4" f/9	$1,649
102 Achromatic 4" f/9	$695
102ED 4" f/9 w/Mount, Tripod & Acc.	$2,795
127ED 5" f/9 w/Mount, Tripod & Acc.	$3,295
152ED 6" f/9 w/Mount, Tripod & Acc.	$4,995
178ED 7" f/9 w/Mount, Tripod & Acc.	$5,995

Optical Tube Only	CALL
#1207 Electric Focuser	144.95
#1664 Electronic Drive	349
#1697 Computer Drive System	749
#1702 Dual Axis Drive System	195
#1812 Electronic DC Adapter	89.95

ACCESSORIES

#62 T-Adapter f/SCT	26.95	Off Axis Guider	79.95
#931 45° Hybrid Erct Prsm	43	f/6.3 Focal Reducer	129.95
Basic Tele-Extender	29.95	**#1205** Focuser	CALL
Camera Adapter 1.25"	29.95	**#1206** Focuser	CALL
Camera Adapter .96"	27.95	6x30 Viewfinder	CALL
Variable Tele-Extender	39.95	8x50 Viewfinder	CALL
DEW SHIELD & DUST COVER	Call	**#607** 25' Cigarette Adpt	25
Piggyback Bracket f/SCT	Call	55 Manual DEC Control	75

Variable Projection Camera Adapter 1.25"	39.95
#927 45° Erect Image Diagonal Prism .96"	42.95
#928 45° Erect Image Diagonal Prism 1.25"	42.95
#929, #930 2" Mirror Diag. w/Eyepiece Holder f/1.25"	99.95
Tube Balance Weight System f/All SCT	CALL
#531 Motor Drive w/Auto Tracking f/4500 Newtonian	CALL
Interface Cable f/LX-200	25
EPOCH 2000sk Sky Software 3.5" Disks	149
EPOCH 2000sk Sky Software CD	179
EPOCH 2000ip Software 3.5" Disks	199

FILTERS

#905 Variable Polarizer 1.25"			49.95
Moon Filter ND96 1.25"	19.95	4 Piece Set 1.25"	49.95
Individual Filters	14.95	Skylight/Dust Seal	44.95

* Nebular	Oxygen III	Broadband*	Narrowband*
#908 1.25"	99.95	79.95	89.95
#910 2"	159.95	119.95	129.95
#911 Rear Cell	149.95	99.95	119.95

DIGITAL ELECTRONIC SERIES

The Most Important Advancement in Beginning and Intermediate Telescopes in 100 Years!

- Object tracking
- Altazimuth mountings
- Electronic controller (EC)
- Autostar computer controller
- Meade StarNavigator software

ACHROMATIC REFRACTORS

DS-70 70mm (2.8"), 700mm f/10	$149.99
DS-70EC 70mm (2.8"), 700mm f/10	$199
DS-80EC 80mm (3.1"), 900mm f/11.3	$449
DS-90EC 90mm (3.5"), 1000mm f/11.1	$499

NEWTONIAN REFLECTORS

DS-114EC 114mm (4.5"), 910mm f/8	$299
DS-127EC 127mm (5"), 1020mm f/8	$349
Optional Autostar Controller	$49.95

SPECIALS

MEADE

390 3.5" 90mm, 1000mm f/11	149
ETX 60 AT 60mm (2.4") w/tripod	275

CELESTRON

NexStar 80 GT 3.1" 400mm **$50** *Rebate*	349
NexStar 114 GT 4.5" 1000mm **$90** *Rebate*	439

Above prices are before rebate-This month only!

HARBORMASTER TELESCOPE

- **Individually Numbered** • **Hand Finished Legs**
- **Brass Tube** $1799.95

BAUSCH & LOMB

2x Barlow 1.25" (#631016) $29.95

BINOCULARS & SPOTTING SCOPES

CELESTRON

BLOWOUT!

8x40 Pro $114.95

9x63 Ultima	CALL	20x80 Giant	368.95
8x32 Ultima	188.95	10x50 Regal	CALL
8x56 Ultima	268.95	8x40 Pro	114.95

MEADE

8x25 Safari Pro	180	10x25 Safari Pro	200
7x36 WA Safari Pro	170	8x42 WA Safari Pro	180
10x42 Safari Pro	190	10x50 WA Safari Pro	200
7x42 WA Rainforest Pro	480	8x56 Rainforest Pro	500

Nikon® SPORT OPTICS

You'll Never See Things Quite The Same Again!

8x30 E **257** 10x35 E **299**		10x70	1048.95
8x32 E Superior	CALL	7x50 Prostar	721.95
10x42 E Superior	CALL	10x40 Lookout IV	102.50
12x50 E Superior	CALL	10-22x50 Scoutmaster XL	135

SPOTTING SCOPES

Fieldscope (60mm)			347.95
Fieldscope 60 II	574.95	60 II Angled	634.95
Fieldscope 78 ED	1229.99	78 ED Angled	1299.99

Leica®

SPOTTING SCOPES
APO TELEVID 77mm
Ask About Leica's Passport Protection

Kowa

77MM SERIES SPOTTING SCOPES

TSN-3	$799.95
TSN-4	$649.95

82MM SERIES WATERPROOF SPOTTING SCOPES

TSN-821 Angled	CALL
TSN-822 Straight	CALL
TSN-823 Angled	CALL
TSN-824 Straight	CALL

Check Out Our Special Package Pricing on 820 Series Spotting Scopes
Package includes: Scope, 20-60x, Case & Tripod

ZEISS

Special! 15x60	$1,849
20x60 Image Stabilizer	CALL
Spotting Scopes	CALL

Canon

IMAGE STABILIZERS
10x30 • 12x36
15x50 AW • 18x50 AW
$50 Rebate!

FUJINON

SPECIAL! 7x50 FMTRC-SX w/Compass			499.95
8x30 FMT-RSX	CALL	10x70 FMT-SX w/Case	CALL
7x50 FMT-SX w/Case	CALL	16x70 FMT-SX w/Case	CALL
Super 80 Scopes w/Zoom & Case			CALL

C90 Multicoated Spotter Outfit

With Free T-Mount!

#81013

$299.95

CELESTRON

BAUSCH & LOMB BUSHNELL

SPOTTING SCOPES

Discoverer 15-60x			176.95
Discoverer T-Mount	11.95	Camera Adapter	13.95
Spacemaster	149.95	Kit	247.95
Spacemaster Armored	163.95	Kit	259.95
Spacemaster Zoom Black Armored			226.95

All Kits Include: 15-45x Eyepiece & Case or Pouch

SWAROVSKI OPTIK

SPOTTING SCOPES
AT-80 • ST-80
AT-80 HD Angled
ST-80 HD Straight

ALL ORDERS ARE SUBJECT TO AVAILABILITY AND VERIFICATION. ORDERS ONLY CALL 888-221-0828 • INFORMATION & NY STATE CALL (718)437-8810 **Orders**
ORDER STATUS & CUSTOMER SERVICE (718) 437-8899 •
24-HOUR FAX LINE (877) 863-6288• STORE INQUIRIES (718) 436-6262. Shipped Promptly
- Most Major Credit cards, Money orders & personal checks accepted for payment. COD orders are accepted but may require a deposit, personal checks may require up to 14 days to clear. All orders are subject to verification & acceptance. Shipping, handling & insurance are additional,please call/write for exact details.
4-day money-back guarantee (less shipping) provided merchandise is returned in new condition, unused as received with papers & packaging intact. We gladly accept and reply to written or faxed inquiries.
Ad prices available while supplies last. This ad supersedes all previous ads. Focus camera is not responsible for typographical errors. Hours: Mon.-Thurs. 9-7, Fri. 9-2, Sun. 10-6.

America's Largest Stocking Authorized Astronomy Dealer!

888-221-0828

N.Y. STATE & OVERSEAS: **718-437-8810**

E-MAIL ADDRESS: **orders@focuscamera.com**

Order on the Web: **www.focuscamera.com**

We ship our orders promptly!

CELESTRON

SCHMIDT-CASSEGRAINS NexStar 8

There is no substitute for size. With Celestron's legendary 8" optics, now you can see deeper into space with the same ease as with the innovative NexStar 5. Images in the NexStar 8 are over two times brighter than with a 5" telescope.

With the touch of a button, the NexStar 8 will open door to planets, galaxies and nebulae that you have never experienced in your lifetime. Exquisite design, pinpoint computer control and stability come together in one dynamic package.

NexStar 11 GPS	$2,299
NexStar 8 8", 2032mm f/10	1,499
NexStar 5 5", 1250mm f/10, w/**FREE** tripod	1,149
NexStar 60 ST ***NEW!***	99
NexStar 60 GT ***NEW!***	249
NexStar 80 HC ***NEW!***	199
NexStar 80 GT ***NEW!***	349
NexStar Tripod	175
G-3 3.5", 1000mm f/11	499
G-5 5", 1250mm f/10	699
G-8 8", 2032mm f/10	999
G-9 1/4 9-1/4", 2350mm f/10	1,299
CM-1100 11", 2800mm f/10	3,199

REFRACTORS

Firstscope 80 Series
80mm (3.1")
3 Models Avail.

Firstscope 70 Series
70mm (2.8")
3 Models Avail.

Firstscope 60 Series
60mm (2.4")
4 Models Avail.

Firstscope 60	$79
Firstscope 60 Equatorial	$139
Firstscope 80 Equatorial	$299
C80-HD 80mm (3.1"), 900mm f/11	$349
C102-AZ 102mm (4"), 1000mm f/10	$329
C102-HD 102mm (4"), 1000mm f/10	$499
CR-150-HD 150mm (6"), 1200mm f/8	NEW!

NEWTONIANS

NEW! **NexStar 114 HC** 114mm (4.5")	$209
NEW! **NexStar 114 GT** w/Go To	$439
Firstscope 76 Equatorial 76mm (3")	$129
C114-HD 114mm (4.5"), 900mm f/8	$329
C150-HD 150mm (6"), 1000mm f/7	$499

STAR HOPPER DOBSONIANS

4.5"	$239	6"	$399	8"	$499

EYEPIECES & VIEWING ACCESSORIES

Diagonal, Prism Star	39.95	Diagonal, Mirror 2"	129.95
Diagonal, Erect Image 45°			39.95
Diagonal, Erect Image 90°			49.95
Plossl 1.25" 32, 40mm	49.95	Tele-Extender Dlx	48.95
Plossl 1.25" 6.3, 7.5, 10, 12.5, 17, 20, 26mm			39.95
Ultima 1.25" 5, 7.5, 12.5, 18mm			74.95
Ultima 1.25" 24, 30, 42mm			94.95
Ultima 1.25" 35			99.95
LV Series 1.25" 5, 6, 9, 10, 15mm			94.95
LV Series 1.25" 2.5, 4, 12, 20, 25mm			109.95
LV Series 1.25" 8-24mm Zoom			159.95

BARLOWS

2x 1.25"	39.95	2x .96"	19.95
2x 1.25 Ultima	62.95	2x .96" Dlx	44.95

FILTERS

4 Piece Filter Sets	49.95	Skylight Filter	44.95
Moon Filter 1.25"	19.95	Solar Filters	CALL
LPR Filter Model A 1.25"			59.95
LPR Filter Model B f/Back Threads of SC's			84.95
Polarizing Filter Set 1.25"			42.95

SCHMIDT-CASSEGRAINS CELESTAR 8 COMPUTERIZED

Engineered for unsurpassed optical performance in an affordable, full featured Schmidt-Cassegrain telescope of large enough aperture to do serious deep-sky observing. This telescope is carefully crafted and manufactured in the USA for dependable quality of the highest caliber. It offers the lowest price ever for a Celestron fork mounted 8" telescope.

CELESTAR 8 8", 2032mm f/10	$1,099
CELESTAR 8 Computerized	$1,599
CELESTAR 8 Deluxe	$1,699
CELESTAR 8 DLX Computerized	$2,199
ULTIMA 2000 8" 2032mm f/10 2032mm f/10 w/Go To System	$2,699
CM-1400 14", 3910mm f/11 **(IN STOCK!)**	$5,299

SPOTTING SCOPES

C5 Spotter

- Fully multicoated optics
- Excellent light gathering ability
- Standard 8x20 erect image finderscope
- Near focus of 20'
- 45° erect image diagonal & 26mm Plossl 48x eyepiece – both 1.25"
- 22mm eye relief and 1° field of view with standard eyepiece
- Fitted with convenient tripod adapter block

C5 Spotter	$599
80mm Wide View	$199
50mm Zoom	$99
60mm Zoom	$69
30mm Mini Spotter	$49

TRIPODS & MOUNTS

Heavy Duty Tripod (93499)	284.95
Photographic Tripod (93596)	99.95
Standard 8" Wedge (93656)	92.95
Heavy Duty Wedge (93655)	239.95
Upgrade Kit f/93655	109.95
Equatorial Mount CG-3	144.95
Equatorial Mount CG-5	369.95
CI-700 Mount	1,859.95
Vibration Suppression Pads	39.95

ACCESSORIES

AC Adapter	18.95	Lens Shades	CALL
Focus Motor	114.95	Motor Drives	CALL
Car Battery Adapter	18.95	T-Adapter f/C90	28.50
Radial Guider	97.95	T-Adapter f/SCT's	24.95
Case f/C5 & C8 (Most Models)			209.95
Counterweight Bar Assembly 8"			89.95
Counterweight Bar Assembly 11"			94.95
DEC Motor f/C5+, Celestar 8, Ultima 9 1/4/11			CALL
Digital Setting Circles			299.95
Flashlight Red Astro Lite			9.95
Flashlight, Night Vision			21.95
Focus Micrometer, Digital			109.95
Hand Controller f/C5+, Celestar 8			49.95
Piggyback Mount 8"			34.95
Reducer/Corrector f/6.3			111.95

FINDERSCOPES

5x24	23.50	7x50 w/Illuminator	159.95
6x30	39.95	9x50	44.95

TELRAD
Finder Scope $36.49

TeleVue Visionary

ALL IN STOCK!

Renaissance-101
101mm (4"), 540mm f/5.4
Available in Green or Ivory

TV-85
85mm, 600mm f/7
Green or Ivory

NEW! **102 TeleVue APO**
102mm (4"),
Green/Black or Ivory/Black

Pronto™

70mm ED, 480mm f/6.8
Available in Ivory or Green

w/1.25" 45° Erect Prism (PGA/PIA)	$925
w/1.25" Star Diagonal (PGO/PIO)	$945
w/2" Star Diagonal (PGD/PID)	$1,085

Ranger

70mm ED, 480mm f/6.8
Available in Ivory, Green or Brass

w/1.25" 45° Erect Prism (RGA/RIA)	$685
w/1.25" Star Diagonal (RGO/RIO)	$695

Ranger Power Package

Includes: 90° Star Diagonal, 20-60x Zoom, 2.5x Powermate & Shoulder Bag (RPP2500)	$1,030

MOUNTS

TELE-POD MOUNT SYSTEM Complete 7lbs Mounting System Ideal for Traveling	$325
Ash Panoramic Mount	$455
Ash Gibraltar Mount	$530
Ash Gibraltar w/Sky Tour	$1,210
Up-Swing Head	$110

EYEPIECES

ZOOM EYEPIECE 8mm-24mm $210

PLOSSL (50°)		PANOPTIC (68°)	
8, 11mm 1.25"	82	15mm 1.25"	210
15mm 1.25"	82	19mm 1.25"	240
20, 25mm 1.25"	95	22mm 2"/1.25"	280
32mm 1.25"	110	27mm 2"	330
40mm 1.25"	110	35mm 2"	365
55mm 2"	228	Barlow Interface	90
RADIAN (60°)		**NAGLER (82°)**	
3, 4mm 1.25"	228	4.8mm 1.25"	175
5, 6mm 1.25"	228	7mm 1.25"	220
8mm 1.25	228	9mm 2"/1.25"	240
10mm 1.25"	228	**NAGLER Type 2 (82°)**	
12mm 1.25"	228	16mm 2"/1.25"	310
14mm 1.25"	228	**NAGLER Type 4 (82°)**	
18mm 1.25"	228	12mm 2"/1.25"	340
NAGLER Type 5 (82°)		17mm 2"	370
31mm 2"	595	22mm 2"	445
BARLOWS			
2x 1.25"	105	2.5x Powermate	168
2x Big 2"	168	4x Powermate	265
3x 1.25"	105	5x Powermate	168

ACCESSORIES

RICH FIELD KIT Includes: 55mm Plossl, 2" Star Diagonal, SCT to 2" E.P. Adptr & 2" to 1.25" E.P. Adptr	410
RICH FIELD PREMIUM KIT w/Everbright 2" Star Diag.	480
Bino Vue Binocular Viewer	1,030
Paracorr Photo/Visual 2" Coma Corrector	259.99
NEW! *Everbright 2" Star Diagonal Mirror*	255
2" Enhanced Star Diagonal	190
1.25" Star Diagonal	75
1.25" Prism 45°	60
Air Chair	150
Basic Qwik Point (QPU)	19.95
Starbeam Projection Finder	180
Camera Adapter 1.25" & 2"	36
Piggy-Cam Camera Adapter	42

ASTRONOMY BOOKS

The Deep Sky: An Introduction

By Philip S. Harrington Here is the perfect reference for anyone, who owns a telescope or a pair of binoculars but doesn't know what to look for amid the constellations. It explains how to find double and multiple stars, variable stars, open and gobular clusters, nebulae, and galaxies — what you'll see when you do.Includes 36 full-page sky charts; equipment, books, and software suggestions; sketches of how deep-sky objects look through a small telescope; and more than 100 black & white photographs. 272 pages.

The Deep Sky: An Introduction			24.95
Backyard Astronomer's Guide			39.95
Nightwatch: A Practical Guide to Viewing the Universe, 3rd Edition			29.95
Star-Hopping for Backyard Astronomers			19.95
Celestron Sky Map			16.95
Meade Star Chart			16.95
Sky Altas 2001			
Deluxe Edition			49.95
Desk Edition	27.95	Field Edition	27.95
Laminated Deluxe Edition			99.95
Laminated Desk Edition			59.95
Laminated Field Edition			59.95

JMI JIM'S MOBILE INC.

Next Generation Computers
Motofocus • NGF Focuser
Wheely Bars • Motodec

THOUSAND OAKS

Precision Glass Solar Filters
Mounted Type 2
Mounted Type 2 Plus
Mounted Type 3 Plus

ASTRONOMY SOFTWARE

RedShift 3	
CD f/Windows	$44.95
CD f/Macintosh	$44.95
The Sky	
Level IV, Ver. 5 CD f/Windows	$239.95
Skymap Pro 6.0	
CD f/Windows	$89.95
SkyChart III CD	$38.95

Take advantage of our *LARGE INVENTORY!* Immediate shipment from stock!

sky Show

september

Saturn dances with the moon while a potentially bright comet brings on its best.

by Martin Ratcliffe and Alister Ling

Larry Landolfi

Venus, Saturn, Mars, and the moon hung over Manhattan on February 21, 1990.

Saturn Dips Behind the Moon

▶ Mark your calendar for the morning of Monday, September 10, and get your telescope and *Astronomy* magazine handy. Visible from Mexico to the Canadian border, the last quarter moon will slide in front of Saturn. Depending on where you live, you may get to see three or four of these special occultation events during the next couple of years. But for others this may be your only chance. Throw in the vagaries of the weather and you might be totally out of luck.

Check out the planet section for observing tips and times for your area. Next month it will be Asia's turn on the 7th, while Europe will have to wait until November 3rd for its chance. Observers in the lower 48 states get two more chances in December. Not to be left out of the action, Alaskans have the chance to watch the moon occult Jupiter just before sunrise on September 12.

Mars has lost its contest. Earth repeats its victory every couple years when it leaves Mars behind in the orbital race. Although the rusty and dusty orange planet continues to fade and shrink, don't give up on it yet; you can still see surface details.

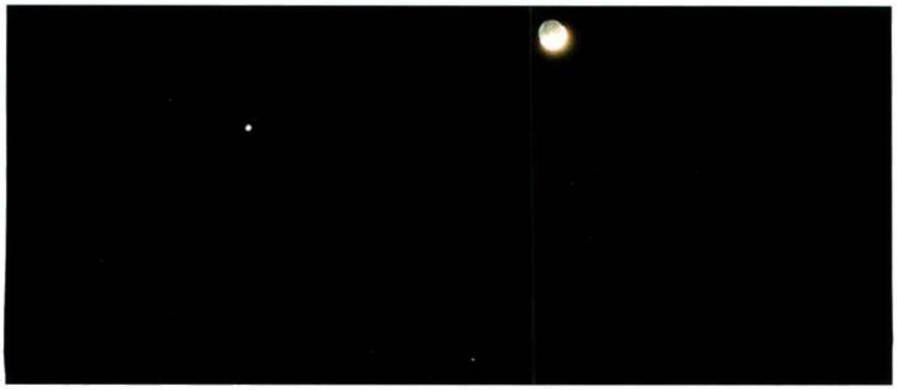
Plan for all-night observing sessions on the weekend of the 15th to the 16th. The morning sky is chock-full of beautiful sights, not the least being Jupiter, Saturn, Venus, and the moon all in a line. At dawn on Sunday morning, Earth's only satellite is a bit less than 24 hours from being reborn at new moon. Its magnificently thin crescent will be resplendent with earthshine as it rises above the eastern horizon.

Meanwhile, periodic Comet Borrelly is cresting in brightness in the lovely star fields of Gemini near the Eskimo Nebula. In the same early morning sky, owners of large scopes will want to track down Comet LINEAR WM1 not far from Capella. LINEAR is expected to rise into binocular visibility in December. Will it break apart and fade abruptly like LINEAR S4 did last year? Time will tell.

Deep-sky observers may rejoice at the arrival of the autumnal equinox on Saturday the 22nd, at 19:04 EDT. It's finally getting dark at a reasonable hour and the nights last longer; Europeans, Canadians, and Americans in the northern states have had to suffer through the short summer nights. Look high overhead for Deneb, one of the prominent stars of the summer triangle. Quietly floating nearby is a delightful galaxy/star cluster pair, as well as a sparkling star cluster perfect for binoculars.

The sun has passed solar maximum, but it has been one of the most active periods on record. Keep an ear open for news reports of fresh solar action that can trigger awesome auroral displays, the mystical dance of the northern lights. With reported sightings farther south than Arizona in the spring, bright aurorae are sure to return this fall.

Venus, Saturn, and the moon triangulated on December 27, 1992.


Jamie Pestel

2001 September

1 The moon passes 3° south of Uranus, 3 A.M. EDT
The moon is at apogee (252,482 miles from Earth), 7:27 P.M. EDT

2 Full moon is at 5:43 P.M. EDT

10 The moon passes 0.2° north of Saturn, 9 A.M. EDT
Last quarter moon is at 2:59 P.M. EDT

12 The moon passes 1.0° north of Jupiter, 8 A.M. EDT (page 63)

15 The moon passes 3° north of Venus, 3 A.M. EDT

16 The moon is at perigee (222,531 miles from Earth), 11:48 A.M. EDT

17 New moon is at 6:27 A.M. EDT

18 Mercury is at greatest eastern elongation (27°), 6 P.M. EDT (page 63)
The moon passes 8° north of Mercury, 10 P.M. EDT

20 Mercury passes 0.9° south of Spica, 4 P.M. EDT
Venus passes 0.5° north of Regulus, 4 P.M. EDT

22 Autumnal equinox is at 7:04 P.M. EDT

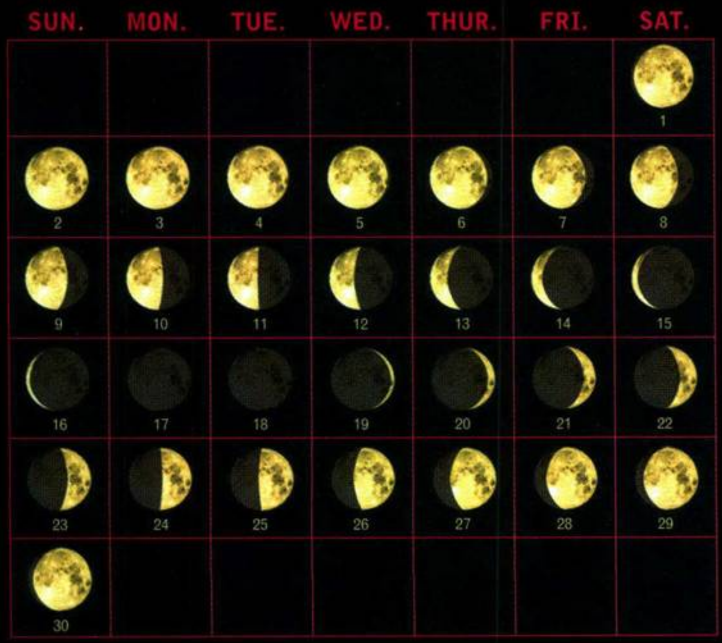
24 First quarter moon is at 5:31 A.M. EDT
The moon passes 2° north of Mars, 9 P.M. EDT

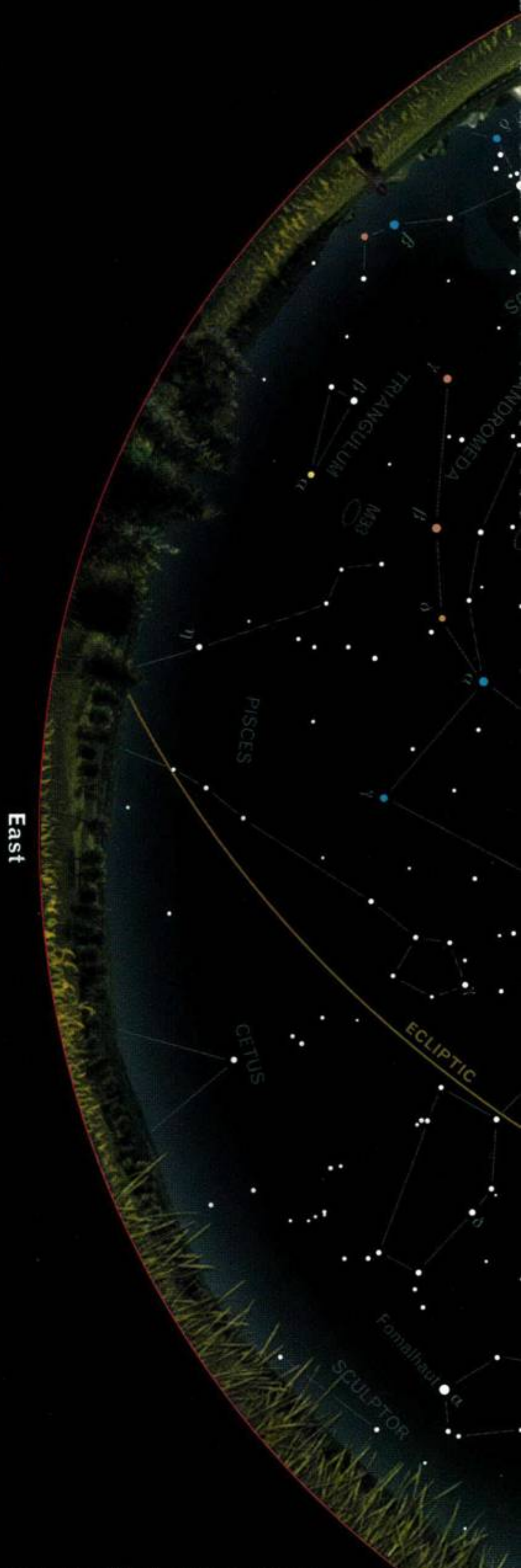
26 Saturn is stationary, 11 P.M. EDT

27 The moon passes 3° south of Neptune, 1 A.M. EDT
Asteroid Fortuna is at opposition, noon EDT

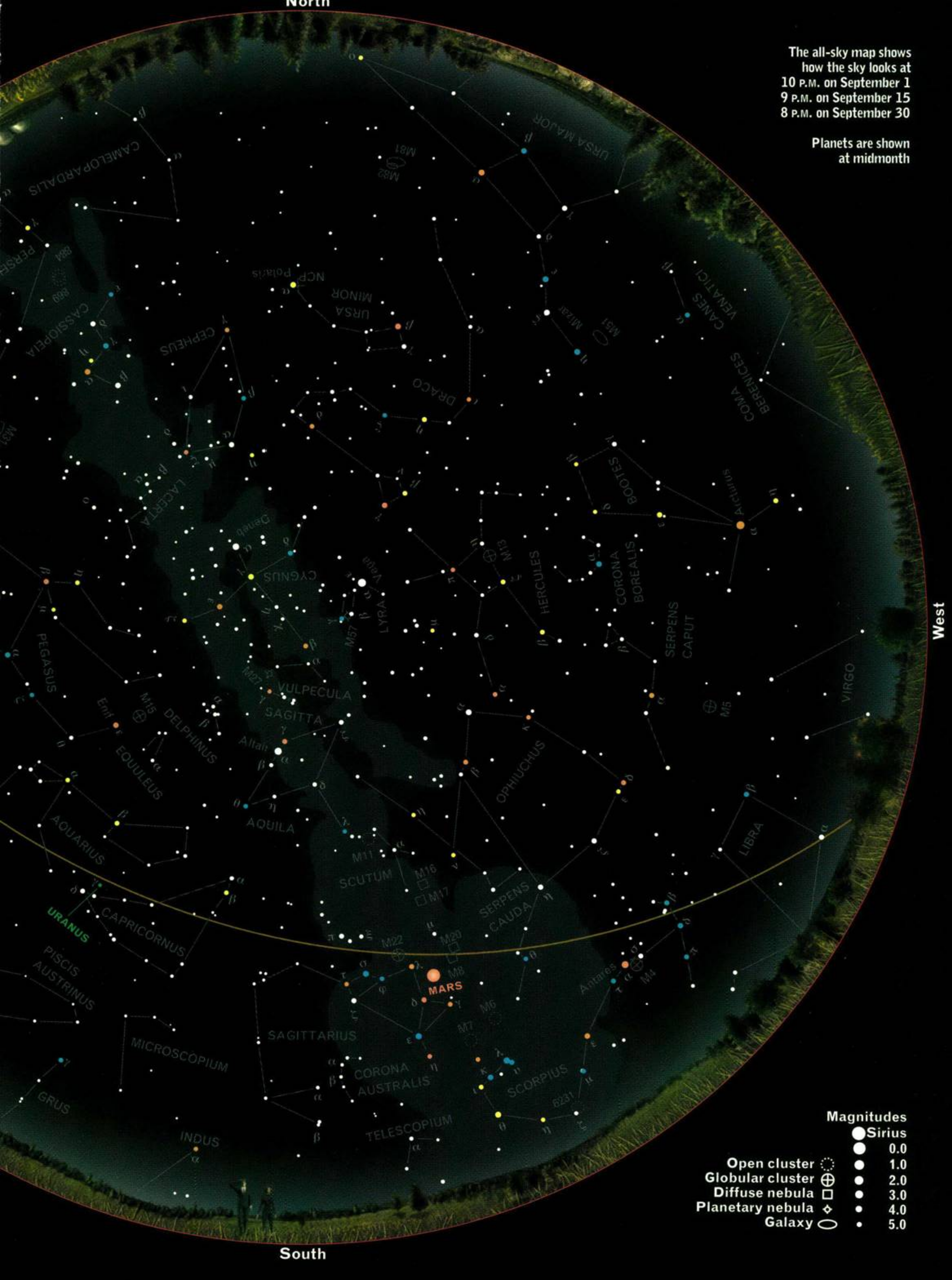
28 The moon passes 3° south of Uranus, 7 A.M. EDT

29 The moon is at apogee (252,144 miles from Earth), 1:34 A.M. EDT





This map portrays the sky at times shown in the upper right corner of the page. Located just outside the map are the four directions: north, south, east, and west. To find stars above your horizon, hold the map overhead and orient it so a direction label matches the direction you're facing. The stars above the map's horizon now match what's in the sky.

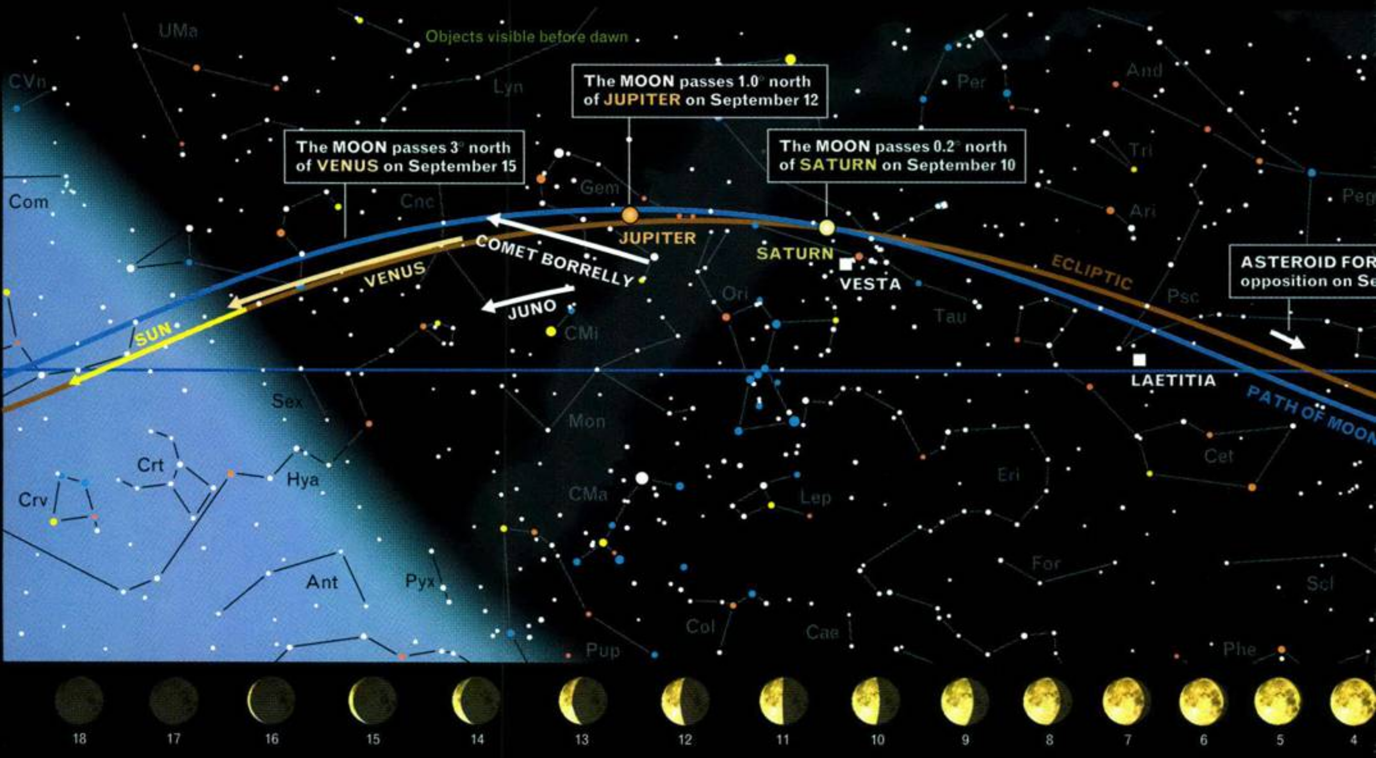

North
South
West
CAMELOPARDALIS
URSA MAJOR
M81
M82
NCP Polaris
URSA MINOR
CASSIOPEIA
PERSEUS
884
869
CEPHEUS
DRACO
CANES VENATICI
Mizar
M51
COMA BERENICES
BOOTES
Arcturus
LACERTA
Deneb
CYGNUS
Vega
LYRA
M57
M13
HERCULES
CORONA BOREALIS
SERPENS CAPUT
VIRGO
M5
PEGASUS
VULPECULA
M27
SAGITTA
Altair
DELPHINUS
EQUULEUS
Enif
M15
AQUILA
OPHIUCHUS
LIBRA
AQUARIUS
M11
SCUTUM
M16
M17
SERPENS CAUDA
URANUS
CAPRICORNUS
M22
M20
M8
MARS
Antares
M4
PISCIS AUSTRINUS
SAGITTARIUS
M6
M7
MICROSCOPIUM
CORONA AUSTRALIS
SCORPIUS
6231
GRUS
TELESCOPIUM
INDUS
Magnitudes
Sirius
0.0
1.0
2.0
3.0
4.0
5.0
Open cluster
Globular cluster
Diffuse nebula
Planetary nebula
Galaxy

The all-sky map shows
how the sky looks at
10 P.M. on September 1
9 P.M. on September 15
8 P.M. on September 30

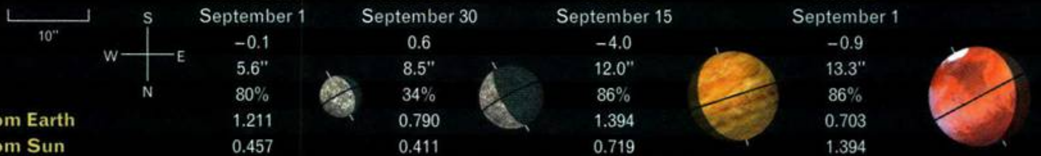
Planets are shown
at midmonth

Path of the Planets

This map unfolds the entire night sky from evening (at right) until sunrise (at left). Arrows and squares show the movements and locations of solar system object


UMa
CVn
Objects visible before dawn
Lyn
The MOON passes 1.0° north of JUPITER on September 12
Per
And
The MOON passes 3° north of VENUS on September 15
The MOON passes 0.2° north of SATURN on September 10
Tri
Com
Cnc
Gem
Ari
Peg
JUPITER
SATURN
VESTA
ECLIPTIC
ASTEROID FOR
opposition on Se
VENUS
COMET BORRELLY
JUNO
Ori
Tau
Psc
SUN
CMi
LAETITIA
PATH OF MOON
Sex
Mon
Cet
Crt
Hya
Crv
Eri
CMa
Lep
For
Scl
Ant
Pyx
Col
Cae
Pup
Phe
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4

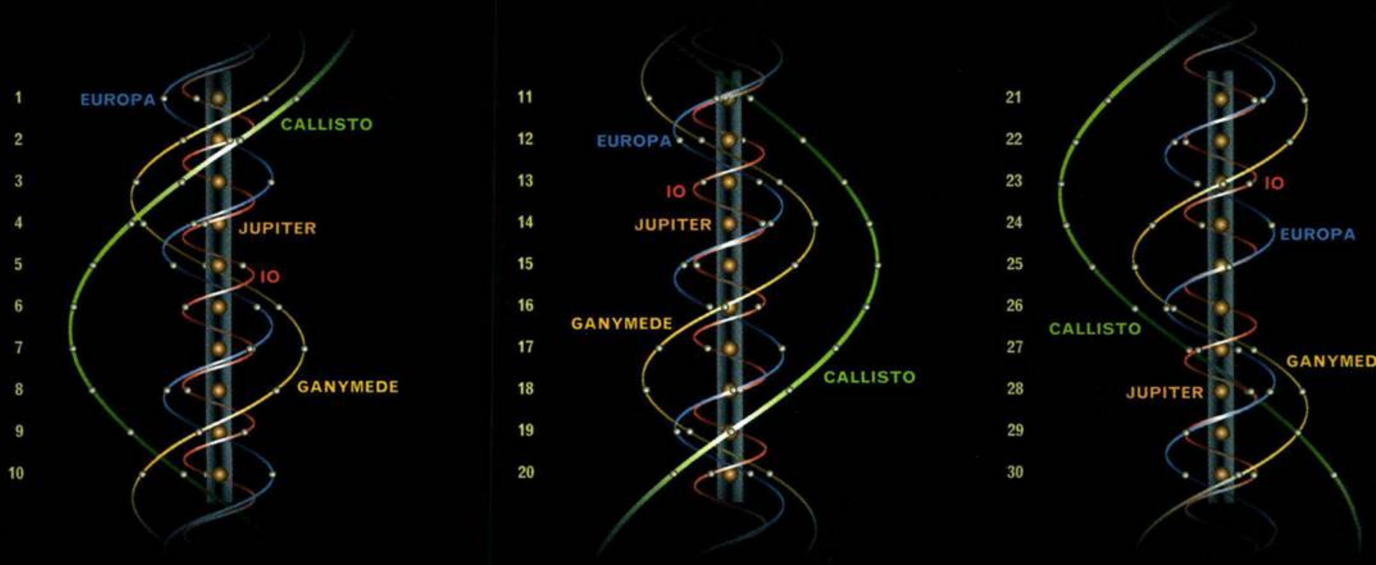
To locate the moon in the sky, draw a line from the phase shown for the day straight up to the curved light-blue line.



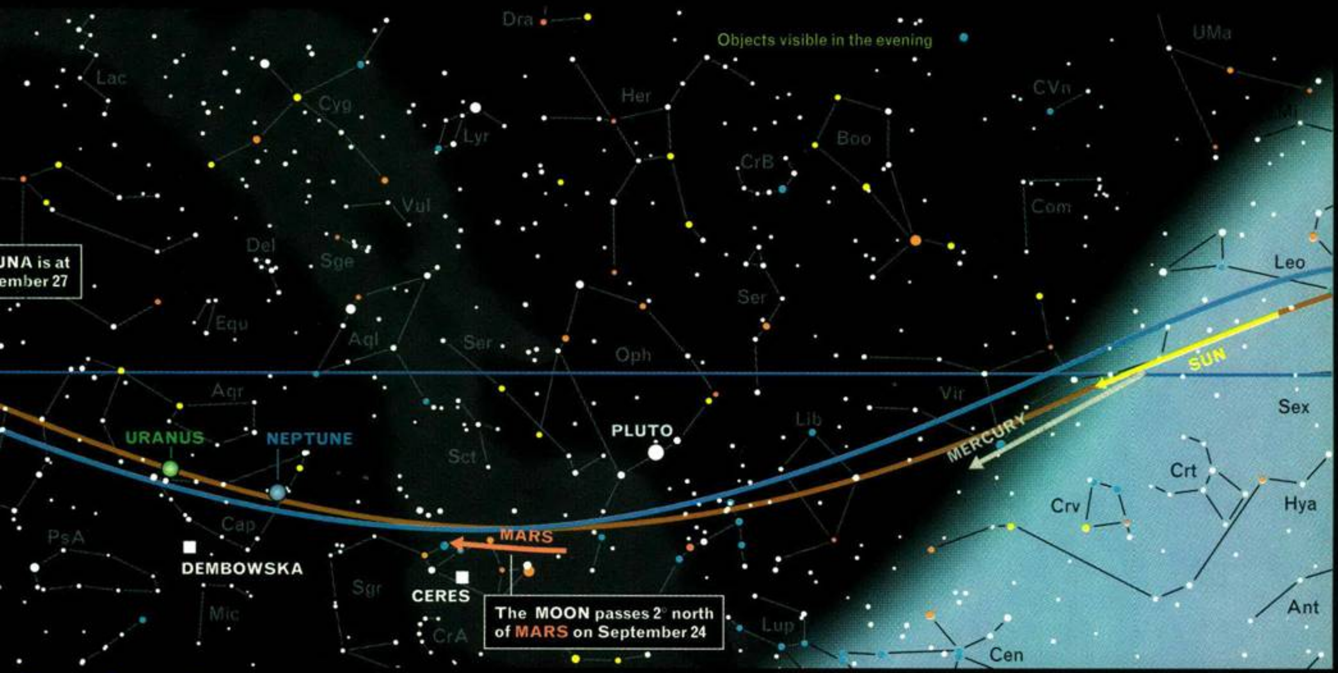
PLANETS	**MERCURY**	**MERCURY**	**VENUS**	**MARS**	**MARS**
Date	September 1	September 30	September 15	September 1	September 30
Magnitude	−0.1	0.6	−4.0	−0.9	−0.4
Angular Size	5.6"	8.5"	12.0"	13.3"	10.8"
Illumination	80%	34%	86%	86%	85%
Distance (AU) from Earth	1.211	0.790	1.394	0.703	0.869
Distance (AU) from Sun	0.457	0.411	0.719	1.394	1.383
Right Ascension (2000.0)	11h59.4m	13h44.4m	9h40.6m	17h43.0m	18h53.1m
Declination (2000.0)	−0°12'	−14°41'	14°37'	−27°00'	−25°48'

Jupiter's Moons

Dots display positions of Galilean satellites at 4 A.M. EDT on date shown. South is at top to match the view in a telescope.

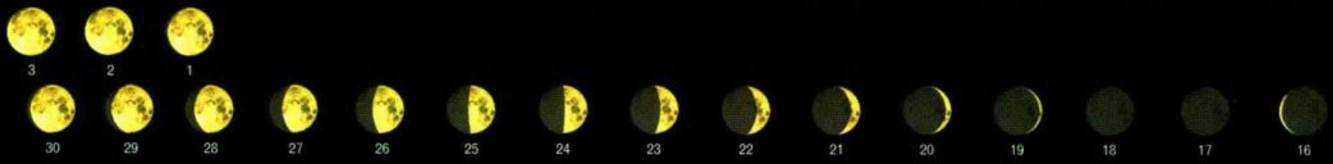


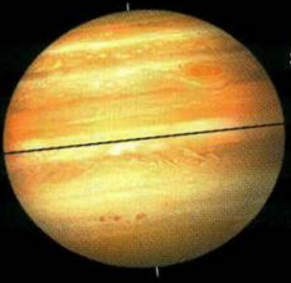
uring the month.

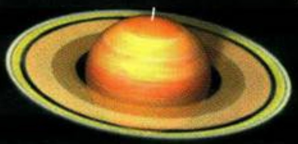

Dra
Objects visible in the evening
UMa
Lac
Cyg
Lyr
Her
CVn
Boo
CrB
Vul
Com
Del
Sge
Leo
Equ
Ser
Aql
Ser
Oph
SUN
Vir
Sex
Aqr
Lib
URANUS
NEPTUNE
PLUTO
MERCURY
Sct
Crt
Crv
Hya
Cap
MARS
PsA
DEMBOWSKA
Sgr
CERES
Mic
CrA
Lup
Ant
Cen

UNA is at
ember 27

The **MOON** passes 2° north of **MARS** on September 24


3
2
1
30
29
28
27
26
25
24
23
22
21
20
19
18
17
16

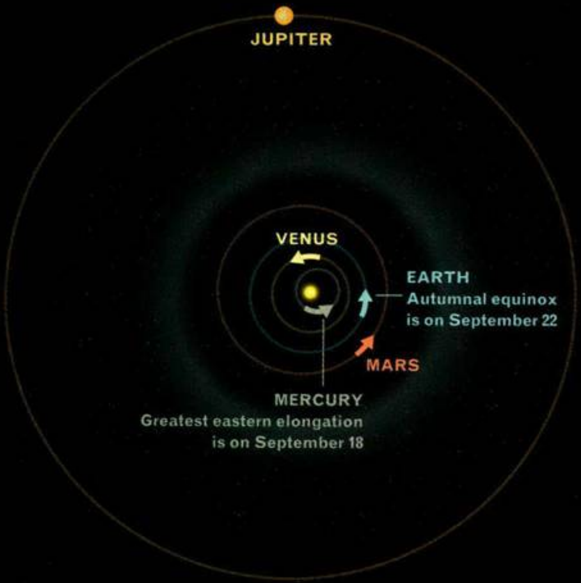




JUPITER	SATURN	URANUS	NEPTUNE	PLUTO
September 15	September 15	September 15	September 15	September 15
−2.1	0.0	5.7	7.9	13.8
36.6"	18.7"	3.7"	2.3"	0.1"
99%	100%	100%	100%	100%
5.385	8.891	19.107	29.391	30.571
5.132	9.075	19.979	30.099	30.423
6h52.4m	4h55.0m	21h37.3m	20h34.4m	16h50.1m
22°42'	20°47'	−14°59'	−18°35'	−12°14'

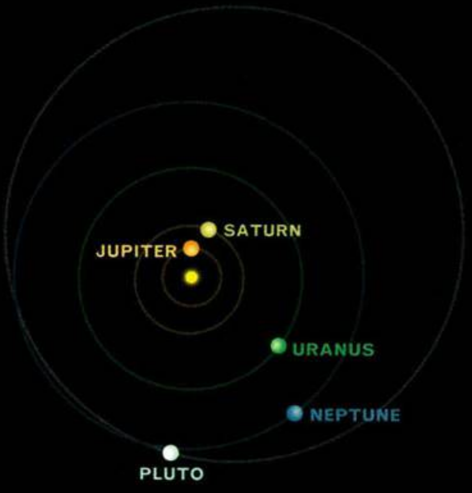
The Planets in Their Orbits

Arrows and dots show planets' positions during the month.


JUPITER
VENUS
EARTH
MARS
MERCURY

EARTH Autumnal equinox is on September 22

MERCURY Greatest eastern elongation is on September 18

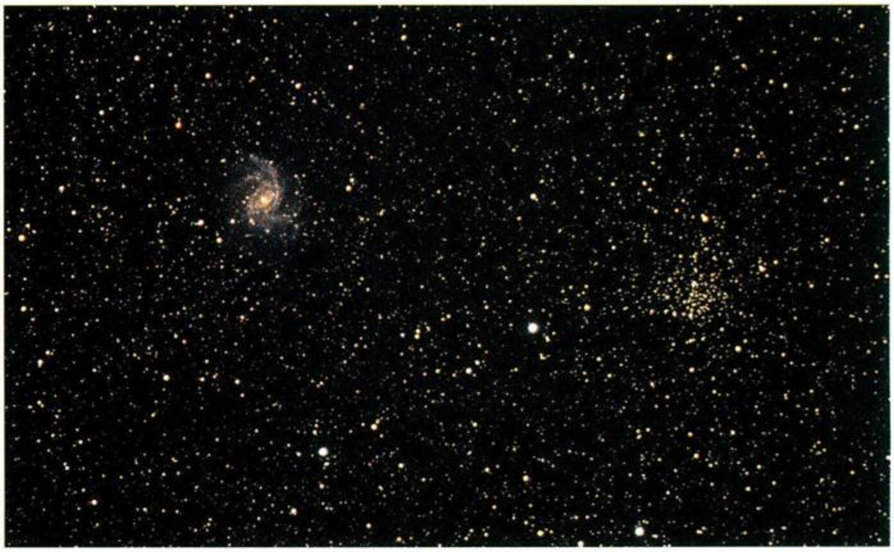

SATURN
JUPITER
URANUS
NEPTUNE
PLUTO

Side-by-Side in the Starry Sky

Get more out of your observing time by studying two objects in the same field of view. The brightest pairs are in the famous Messier deep-sky catalog. Most are of the same type, such as galaxies M81 and M82, but the duo can give you a neat sense of depth perception. Try M97 and M108, a planetary nebula and a galaxy, low in the northwest. Higher in the sky, just beyond the grasp of Messier's small scope, lies one of today's favorites, a bright star cluster and a face-on galaxy pair in Cepheus.

Deep-sky observer extraordinaire Sir William Herschel was the first to lay eyes on NGC 6946 and NGC 6939 back on September 9, 1798. How thrilled he would have been to know the truth, that NGC 6946 is in fact a huge spiral galaxy, similar to our own Milky Way, but some 22 million light-years distant. The star cluster NGC 6939 is in our celestial backyard, only 4,000 light-years away.

Herschel's sharp eyes could tell that something was different about the galaxy. He wrote that it "seems to consist of stars, the nebulosity is of the milky kind. It is a pretty object." The stars that Herschel saw are all in the foreground, belonging to the Milky Way Galaxy. Since 1917 there have been six supernovae spawned in NGC 6946. When a star blows itself apart at the end of its life, it briefly shines across the depths of space, as bright as its entire parent galaxy, becoming visible to amateur astronomers. The last NGC 6946 supernova was in 1980, so we're overdue for another. Will there be an extra star when you turn your telescope on it?



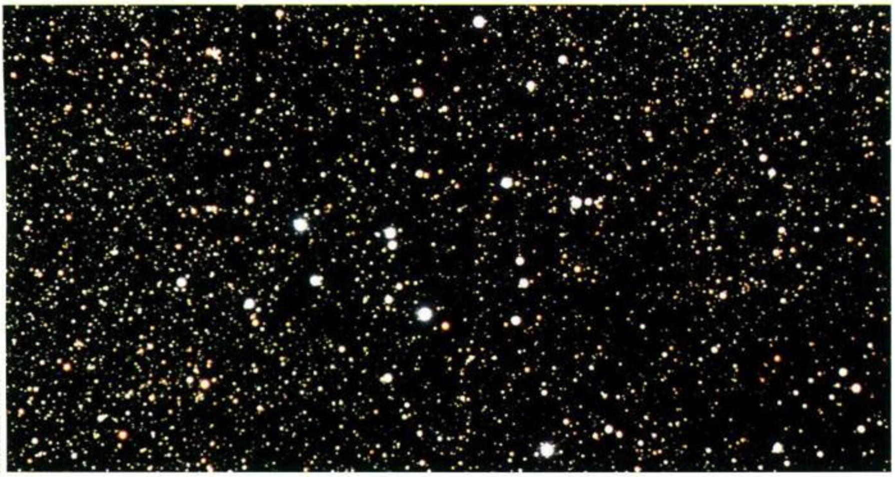
Carl Weber

Spiral galaxy NGC 6946 and open cluster NGC 6939 are celestial neighbors.

Just 40' northwest, a bit more than a moonwidth, lies "a beautiful compressed cluster of small stars, extremely rich, of an irregular figure." Herschel would have found NGC 6939 all the more remarkable if he had modern optics to see both this star cluster and the galaxy at the same time. In several ways NGC 6939 resembles the Wild Duck Cluster (M11), with its arrowhead shape and areas of small voids.

Choose a night without the moon, during the second or third week of September, and travel to the dark countryside. Although the star cluster NGC 6939 is visible from an urban backyard with an 8-inch scope, it is much prettier against the faint stardust background of the Cygnus-Cepheus portion of the Milky Way.

The bright open star cluster M39 in Cygnus is large enough to observe with binoculars.



Michael Stecker

A Bright Binocular Cluster

Find yourself a deck chair or air mattress and lie back and relax to avoid a crick in your neck. Way up high in northern Cygnus lies M39, a favorite among the star clusters. Face east and find Deneb, one of the bright stars of the summer triangle. Look for the curving chain of 4th magnitude stars down and to the left, consisting of Xi (ξ), Rho (ρ), and Pi^1 (π^1) and Pi^2 (π^2) Cygni. About two binocular fields from Deneb, nestled above this arc, lies the splashy M39.

In many ways it's like the Beehive and the Pleiades clusters; it can be too big for some telescopes. M39 spans more sky than the full moon, so you must use really low magnification; it looks its best between 5x and 40x. If you are in the country, this region of the Milky Way almost rivals Sagittarius; enjoy a leisurely time sweeping with binoculars.

Mars Hangs On

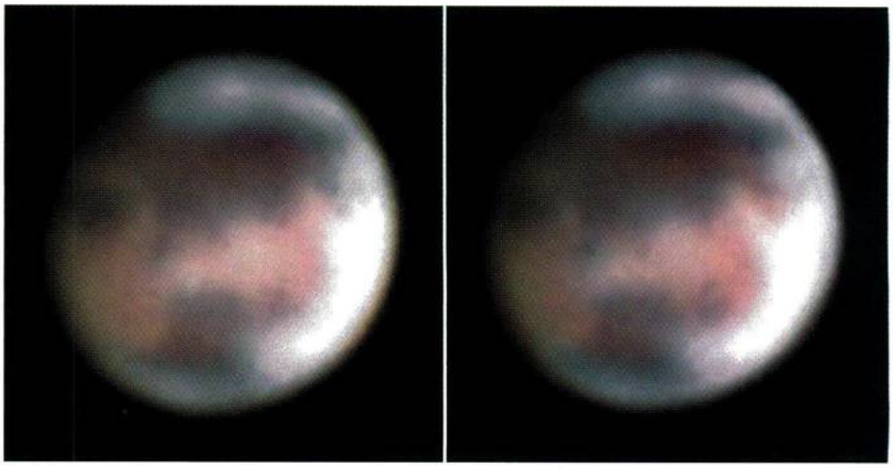
If you want to catch some planetary action this month, plan to do so shortly after sunset, or wait until after midnight. **Mars** is visible as soon as it gets dark and sets a couple hours later, while Saturn rises close to midnight.

The planet can be spotted in the southern sky right after sunset during September, shining brightly at magnitude –0.8 on September 1 and fading to –0.4 by September 30. This is a fraction brighter than the star Vega, which stands overhead in the early evening. Mars looks similar to a bright red warning light that sits atop towers and tall buildings to alert planes at night. But why does it fade? It's because the distance between the Red Planet and Earth increases during the same period, from 65.3 million miles to 80.6 million miles.

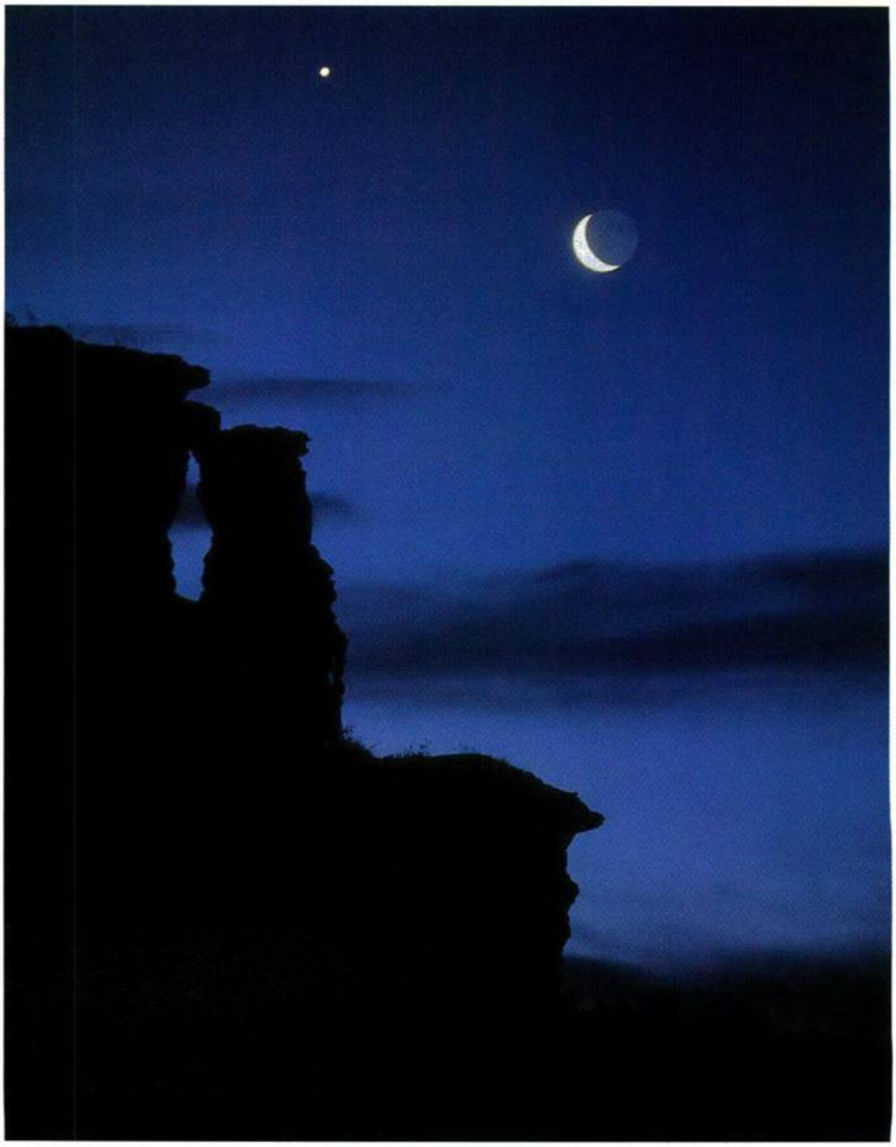
Although Mars is dominant in the sky this month, it is well past its best. The view through a telescope shows a disk a little over half of its June diameter. However, larger scopes will still show a fair amount of detail as the apparent diameter of Mars stays above 10".

To grab a good view of Mars through a telescope, plan to start as soon as night falls, since Mars begins to set quickly. Combine its low altitude with the rapid cooling of the atmosphere after sunset that sets up atmospheric turbulence, and some evenings will result in poor views.

While Mars may not be at its best telescopically, the Red Planet currently traverses the fine, rich star fields in the constellation Sagittarius the Archer. This region of sky is the broadest and richest part of the Milky Way. Sagittarius resembles a teapot, and during the month Mars moves slowly towards the teapot's handle. Nightly exposures of 15 to 30 seconds in duration with a tripod-mounted camera loaded with color film will record this grand procession of the Red Planet across the Milky Way. The first quarter moon



Donald C. Parker



John McNeal

Mars displayed great details on April 26, 2001 (top); the moon and Venus were in conjunction on February 23, 1998 (right).

enters the scene late in the month with Mars lying just 1.6° south on September 24 for the United States. Mars passes 0.6° north of Nunki, also listed in star atlases as Sigma (σ) Sagittarii, on September 30.

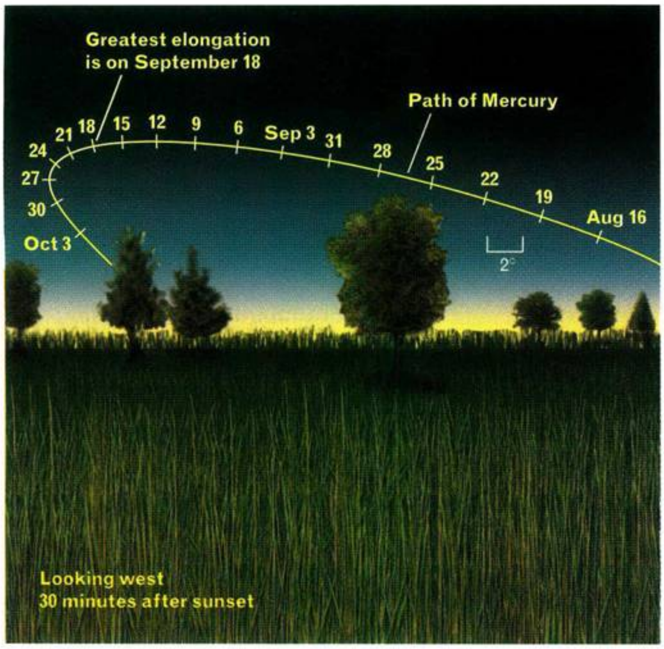
While you're waiting for the sky to darken to observe Mars, keep alert for a brief glimpse of **Mercury**. Viewing this planet represents quite a challenge this month. On September 18 it reaches greatest eastern elongation standing 27° east of the sun, although its southerly position on the celestial sphere makes it difficult to view from the Northern Hemisphere. Yet Mercury will appear to be a double; the 1st-magnitude star Spica lies a little over 1° east of Mercury. Mercury is brighter at magnitude 0.1. In addition to Spica, try to spot the one-and-a-half-day-old moon 7° north of the planet. The view can only be caught in a bright twilight sky because all the objects set within an hour of the sun. Viewing Mercury will require a clear western horizon.

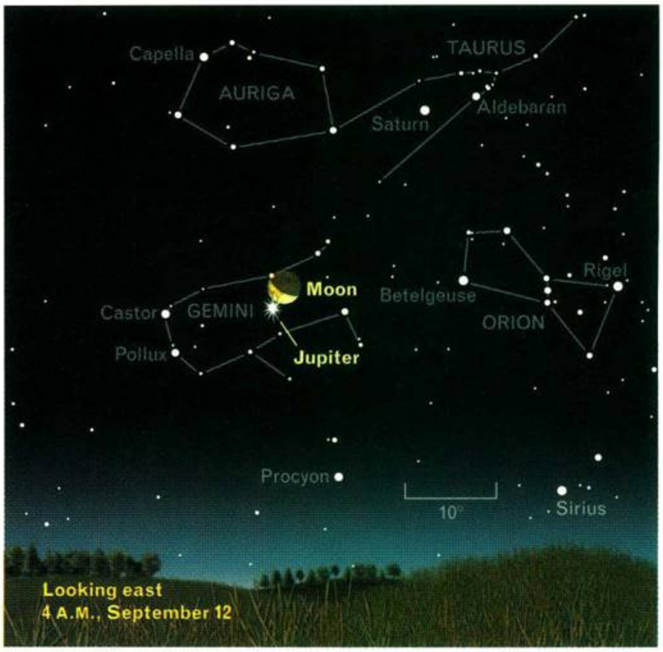
Moving to the later evening, the bluish disk of **Neptune** can be seen at high power in Capricornus the Sea-Goat. Shining at magnitude 7.9, Neptune lies just over 1° southwest of the magnitude 5.1 star Upsilon (υ) Capricorni. **Uranus** also resides in Capricornus. The seventh planet can be found in the same binocular field of view as Deneb Algedi, the magnitude 2.8 star at the northeastern end of the constellation. Through a telescope, Uranus will appear to have gained a bright satellite on September 7 and 8. The new companion is actually a magnitude 7.2 star with the catalog number SAO 164538.

That concludes our early evening planetary fare for the month. Next up is **Saturn**, but you'll have to wait until well after midnight on September 1 for it to clear the horizon. It shines at magnitude 0.2 among the stars of Taurus the Bull. On September 10 a spectacular event takes place. The moon occults Saturn during the early morning hours for observers in the continental United States and Hawaii. Observers west of the Rocky Mountains will see the event in darkness. The sun will already have risen for observers farther east but the occultation will still be visible, as the moon is easy to locate in daylight. Times vary significantly depending on your location. For the Los Angeles area, the occultation begins at approximately 4:54 A.M. PDT, while in the central time zone, the event occurs in daylight at approximately 7:40 A.M. CDT. Saturn's disk and rings take more than one minute to disappear behind the moon's limb. Check with the International Occultation Timing Association's web page (lunar-occultations.com) for more accurate timings for your precise location.

Two hours after midnight, **Jupiter** rises in the east-northeast. Earlier this year Jupiter, as an evening object, was found in Taurus. Now the giant planet is situated among the stars of Gemini the Twins. Jupiter's faster-paced orbit has carried it far ahead of Saturn, and the two planets are now separated by nearly 30°. A year ago they were much closer. Jupiter stands one moon-width to the southeast of the last quarter moon during the early morning hours of September 12 for the continental United States, but observers in Alaska will see the moon occult Jupiter at approximately 3:18 A.M. local time.

A few days later, on September 15, the waning moon passes less than 4° east-northeast of **Venus**. Venus is typically very bright and this month is no exception, as it shines at magnitude –3.8. A telescopic view shows it to be almost 90 percent illuminated and of similar apparent diameter to Mars. Venus's phase increases as it moves toward a location on the far side of the sun with respect to Earth.





Meteors and Moons

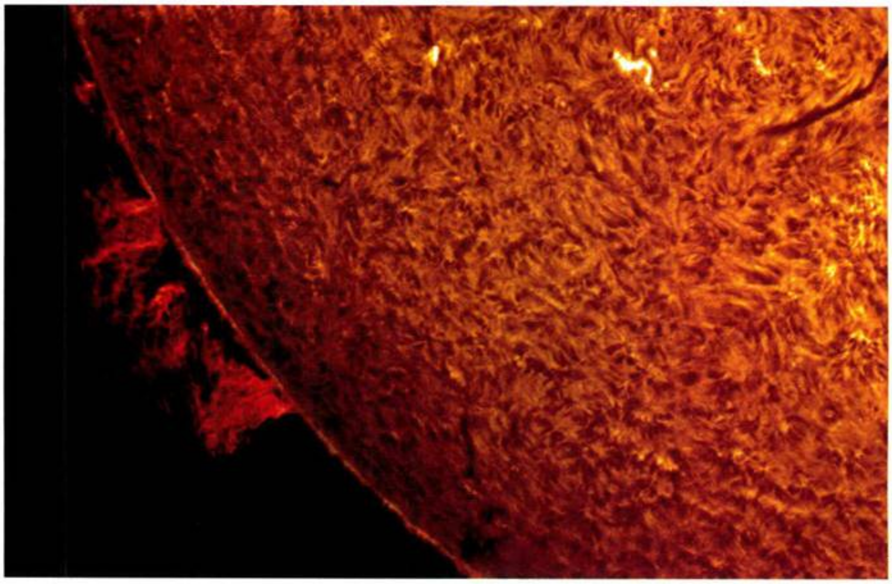
Targeting the Sun

This month we take a special look at the sun, although this must always be done safely. The best way to view the sun is by projecting the solar image onto a piece of white card. Alternatively, if you have an approved solar filter, you can view the sun directly by placing the filter over the front of the telescope.

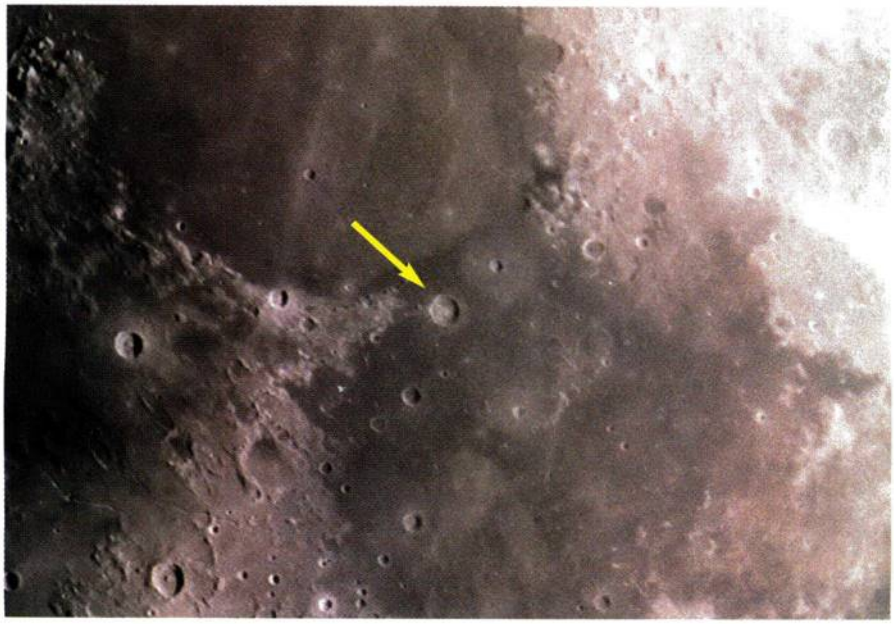
Currently the sun is very active, producing many sunspots of differing sizes and shapes. Sunspots come and go in an 11-year cycle, and observations in the past year indicate we are just past the peak. Drawing or photographing the sun each day shows sunspots tracking across the sun, revealing its rotation. Each time you see a sunspot, remind yourself that Earth would fit across the diameter of the sun 109 times. With many sunspots at least as big as Earth, recognizing their true size is one of many awe-inspiring moments while observing the sun.

If watching the sun directly is not possible, you can keep track of its daily appearance via spaceweather.com. In addition to showing a daily view of the sun online, this website reports on more violent eruptions on the solar surface and indicates if any of these eruptions, called coronal mass ejections, are heading toward Earth. If one is on its way, a display of the northern lights might result in the following couple of days. Typically confined to the northern latitudes, visibility of particularly active northern lights can stretch as far south as Georgia or California, just as they did earlier this year.

The recent introduction of reasonably priced (less than $1,000) Hydrogen-alpha filters has opened up the field of regularly observing prominences on the sun. A phenomenon typically confined to visibility during a total solar eclipse, prominences change over a period of a few minutes, providing some dramatic features for the budding amateur solar scientist to track.


Jack Newton

Spectacular solar prominence activity occurred on December 26, 2000.


Philippe Durville

The crater Plinius (arrow) offers a beautiful target for lunar observers.

Plinius on the Moon

This fine, crisp, 30-mile-wide crater is the largest crater that lies right at the junction of Mare Tranquillitatis and Mare Serenitatis. It has a well-defined rim and a central mountain peak surrounded by a partially flooded floor. Located around the region of the crater are many rilles, best observed when the sun provides a low angle of illumination over the area. Sunrise on the region occurs on September 22, with increasing illumination occurring over the following two days. To the west of Plinius is an extensive range of mountains that includes the crater Menelaus. Northeast of Plinius is a smaller, well-defined crater called Dawes, which joins Plinius in guarding the boundaries between the two great maria. The sun sets over the region in the days following September 7, when an ever-increasing shadow falls across the floor of Plinius.

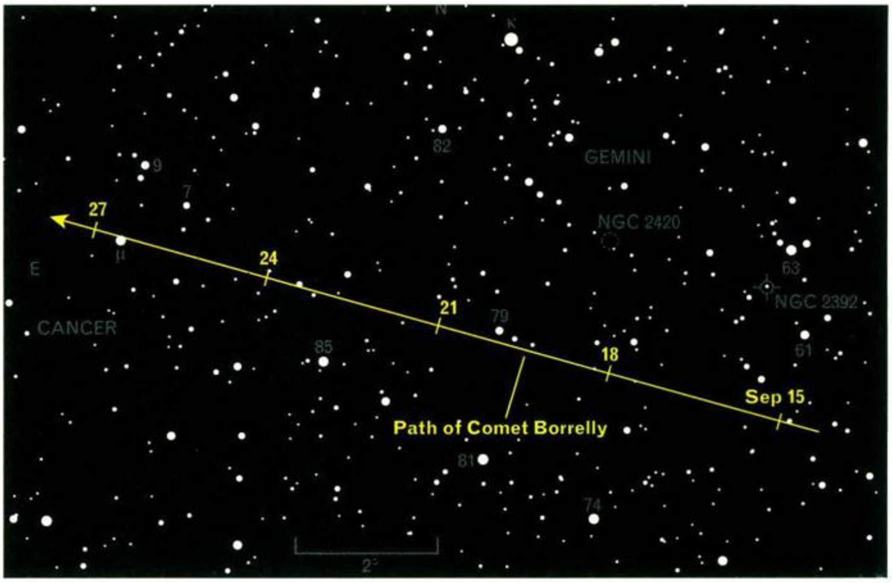
Exit Borrelly, Enter LINEAR

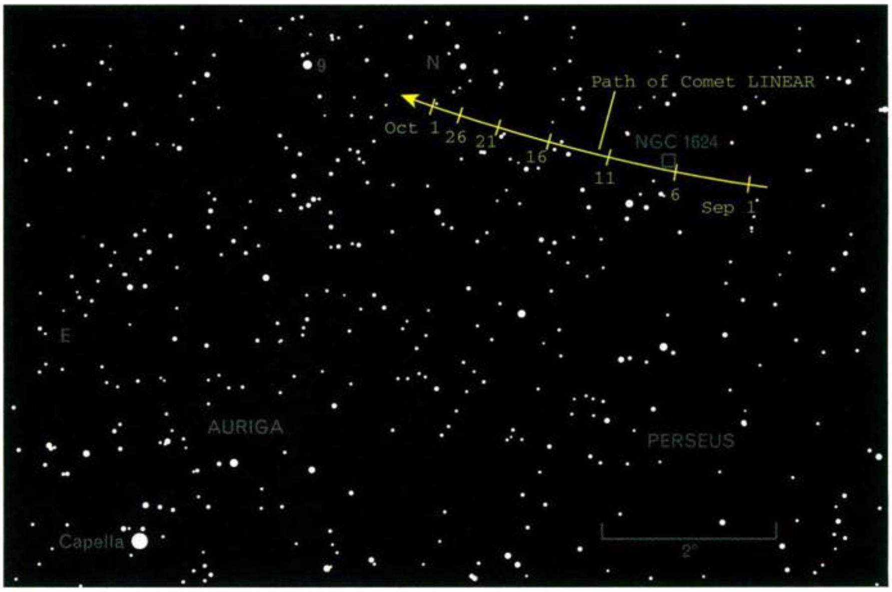
Periodic Comet Borrelly is in the midst of a fine pass through our morning skies. At about 10th magnitude, P/Borrelly will look something like a faint galaxy from the Messier list. On the morning of the 16th, it lies just 2° from the famous Eskimo planetary nebula, as well as the faint but rich star cluster NGC 2420. You'll need to be under country skies in order to see the fan of Borrelly's tail.

Eager for a comet to be visible in binoculars? LINEAR WM1 is waiting in the wings, predicted to reach about 6th magnitude in December. In the meantime, you can catch a glimpse of it now in scopes of 10 inches or bigger. It, too, is a morning object, arcing high overhead by dawn, not far from the golden luminary Capella.

The best times to catch both of these dirty snowballs are during the new moon nights of the weekend of September 15 and 16 and the following days, when the moon is in the evening sky. City light pollution veils the view of these gray objects, so venture out to a darker country sky for observing. You may want to bring along a 12-volt hair dryer to de-mist the optics. During the long, cool night, dew and water drops collect in profusion on mirrors and lenses.

A great opportunity for astroimagers comes on the mornings of the 6th to the 8th, when LINEAR WM1 lies less than 10', ⅓ of our moon's apparent width, from the small cluster and nebula combo NGC 1624 in Perseus. This conjunction is probably too difficult for visual observers because of the moon's glare.





Evening Asteroids Cruise the Southern Sky

Rising in the eastern sky is the constellation Aquarius, home this month to the main-belt asteroid 10 Hygeia. It lies one binocular field south of the modestly prominent Y-shape grouping of stars called the Water Jar. A few 10th-magnitude stars in this region appear similar in brightness to Hygeia. From September 13–15, this 270-mile (430-km)-wide rock, named after the goddess of health, lies 10' south of 51 Aquarii.

While you're in the area, check out the middle star of the Water Jar. Zeta (ζ) Aquarii is a binary star that can be split in small backyard telescopes. The colorless pair, of similar brightness, are separated by just over 2". You'll need at least a 2.4-inch scope working at its maximum of 120x to split it.

Ceres, the number 1 asteroid, is more than twice the size of Hygeia and a full magnitude brighter. As luck would have it, Ceres will scrape past the globular cluster M54 on the night of September 30th, repeating a similar performance from the end of July. At magnitude 8.9, Ceres will outshine any of the cluster stars, whose brightest are 15th magnitude. You can find Ceres at the bottom of Sagittarius's Teapot, a binocular field south of Mars. ■

Martin Ratcliffe is Director of Theaters at the Exploration Place in Wichita, Kansas. Alister Ling is a meteorologist working for Environment Canada in Alberta.

ORION
TELESCOPES & BINOCULARS

Hundreds more products online!
telescope.com

Our 26th Year!

TELESCOPES

Orion SkyView™ Deluxe EQ Series
Telescopes for *Today's* Amateur Astronomer

SkyView™ Deluxe 8 EQ Newtonian
A deep-sky lover's delight! Big, diffraction-limited 200mm **parabolic** primary mirror of 800mm focal length (f/4) delivers vivid, wide-field views of nebulas, clusters, and galaxies. Gathers 73% more light than a 6" scope, yet is nicely portable. Enameled steel tube and aluminum R&P focuser (1.25").

$649

SkyView™ Deluxe 6 EQ Newtonian
Outstanding for deep-sky and planetary/lunar study. Features a precision 6"-diameter **parabolic** primary mirror and aluminum R&P focuser. Enameled steel optical tube. Focal length 750mm (f/5).

$499

SkyView™ Deluxe 4.5 EQ Newtonian
An exquisite combination of form, function, and affordability for the serious beginning astronomer. The rolled steel optical tube houses a precision-polished 4.5" primary mirror of 920mm focal length (f/8).

$379

Free! $89 Value! *Astronomy CD-ROM with any telescope on this page.*

Look What's Included
- *New heavy-duty EQ mount*
- *TWO 1.25" Plössl eyepieces*
- *6x30 achromatic finder scope*
- *Moon filter (1.25")*
- *Gold-anodized aluminum tripod*

The SkyView Deluxe come with two fully coated Plössl eyepieces (25mm and 9mm) and a Moon filter. The eyepieces have fold-down rubber eyecups and are threaded for filters.

Observer™ 70mm Altaz Refractor
Great for the home with a view! The altazimuth mount is very simple to use. We specially engineered it to provide much greater stability than the standard "off the shelf" altaz mounts. Altitude micro-motion control included.

$149

Orion ShortTube™ 4.5 EQ Reflector
This is a complete telescope package, inclduing 5x finder scope, rack and pinion focuser, two fully coated 1.25" Kellner eyepieces: a low-power 25mm (40x) and a high-power 10mm (100x), plus hardwood tripod with accessory tray. It's a terrific starter scope that's delightfully short on bulk!

$199

AstroView 120ST EQ
A great experience in rich-field astronomy. With its 600mm focal length it gives 66% wider fields of view for any eyepiece than longer-tube refractors. The 120mm objective lens is multi-coated, and the cast metal focuser accepts either 2" or 1.25" accessories. Mounted on a sturdy EQ-3 mount. Includes 6x30 finderscope, 90| mirror star diagonal, two 1.25" Plössl eyepieces: 25mm and 10mm.

$519

Orion SkyQuest™ XT Dobsonian Telescopes
Big Aperture, Superior Performance, Point-and-View Simplicity

For a fraction of the cost of a little "go to" scope, you can own a telescope with serious *aperture*. See more of the universe—for less—with an award-winning SkyQuest XT metal-tube Dobsonian. It'll keep you up nights.

ENAMELED STEEL TUBE, NOT CARDBOARD!

SkyQuest
SkyQuest
SkyQuest
SkyQuest

SkyQuest XT4.5
Just the right size for younger stargazers, and incredibly easy to master! Adults will love it too, for its portability and crisp optical performance.
Steel tube, 114mm mirror (f.l. 910mm, f/8), 1.25" R&P focuser, 6x30 achromatic finder scope, 25mm (36x) and 9mm (110x) Plössl eyepieces (1.25"), 5" flanged altitude hubs, CorrecTension Friction Optimization, built-in handle, dust cap. Weight: tube 9 lbs., base 8-1/2 lbs.

$229

SkyQuest XT6
The overachieving XT6 will show Jupiter's Red Spot, Saturn's Cassini Division, hundreds of clusters and nebulas, and galaxies tens of millions of light-years distant. Nicely portable and very affordable!
Steel tube, 152mm parabolic mirror (f.l. 1200mm, f/8), 1.25" aluminum R&P focuser, 6x30 achromatic finder scope, 25mm (48x) and 9mm (133x) Plössl eyepieces (1.25"), Moon filter, eyepiece rack, 5" flanged altitude hubs, CorrecTension Friction Optimization, dust cap. Weight: tube 13 lbs., base 24 lbs.

$369

SkyQuest XT8
The XT8's prodigious performance on both solar system and deep-sky denizens have made it the telescope of choice for thousands of astronomers, from beginners to die-hard hobbyists.
Steel tube, 200mm parabolic mirror (f.l. 1200mm, f/6), 1.25" aluminum R&P focuser, 6x30 achromatic finder scope, 25mm (48x) and 9mm (133x) Plössl eyepieces (1.25"), Moon filter, eyepiece rack, 5" flanged altitude hubs, CorrecTension Friction Optimization, dust cap. Weight: tube 19 lbs., base 23 lbs.

$499

SkyQuest XT10
Gulping in over 50% more light than an 8" scope, the XT10 reaches far deeper into space. The sheer number of objects visible in this scope is staggering, and its resolving power brings out detail that will keep you entranced for years.
Steel tube, 250mm parabolic mirror (f.l. 1255mm, f/5), 2" aluminum R&P focuser, big 8x50 achromatic finder scope, 25mm (50x) and 9mm (139x) Plössl eyepieces (1.25"), Moon filter, eyepiece rack, 5" flanged altitude hubs, CorrecTension Friction Optimization, dust cap. Weight: tube 35 lbs., base 23 lbs.

$649

MONEY-BACK GUARANTEE
If you are not completely satisfied with your purchase from Orion Telescopes & Binoculars
100% Satisfaction
for any reason, just return it in new condition within 30 days after delivery for a prompt refund.

24 Hour Toll-Free Orders: (800) 447-1001
Information/Advice: (800) 676-1343
Information Line Hours: M–F 6am–8pm, Sat. 8am–6pm Pacific Time

telescope.com

EYEPIECES & ACCESSORIES

Sirius™ Plössl Eyepieces

You could pay twice the price for other brands of Plössl eyepieces, but why? Sirius Plössls are top-quality, 50° apparent-field (43° 40mm) eyepieces that yield extremely sharp images of impressively high contrast. Ideal for all types of telescopes. Fully-coated optics, rubber eyeguards.

1.25"

6.3mm, 7.5mm, 10mm, 12.5mm, 17mm, 20mm, 26mm	$49.95 each
32mm, 40mm	$59.95 each

Save Big on Sirius Sets!

Need More Than One?

Save on these practical Sirius Plössl sets. (You save on shipping, too!) 1.25" barrel diameter only.

Sirius Plössl Starter Set

And ideal "upgrade" set to replace lower-quality eyepieces, it includes three must-have focal lengths for low-, medium-, and high-power viewing: 26mm, 17mm, and 10mm.

Reg. $149 Set Price **$119**

Sirius Plössl Expansion Set

If you already have the Starter Set, or the 25mm and 10mm eyepieces included with many telescopes, this set provides three complementary focal lengths for medium and high magnifications: 20mm, 12.5mm, 7.5mm.

Reg. $149 Set Price **$119**

Sirius Plössl Power Pair

For planetary and lunar viewing especially, these 12.5mm and 7.5mm high-power oculars will have you discovering new detail. Even if you already use a 9mm or 10mm eyepiece, get this pair to add more magnification options.

Reg. $100 Set Price **$79.90**

Explorer II™ Eyepieces

The cost of accessories for your telescope can really add up. Now you don't need to spend a fortune for good quality oculars. Our Explorer II models are attractively priced for even limited budgets. Their 3 and 4 element glass lens configurations provide a 50° apparent field of view. They're fully coated with anti-reflection material to maximize transmission of incoming light and improve contrast. The anodized aluminum barrels are precisely machined and internally blackened to prevent stray light reflections. They're also threaded for filters. Available in 25mm, 17mm, 13mm, 10mm, and 6mm focal lengths.

$27.95 each

Orion Lanthanum Eyepieces

Our rare-earth lanthanum eyepieces have new chrome exteriors but the same superior image correction and generous 20mm eye relief of the previous models. Ideal for eyeglass wearers! Fully multi-coated optics with six to eight lens elements. Apparent field 50° (7.5-25mm), 45° (2.3mm-5.2mm). Pop-down rubber eyecups. Made in Japan. 1.25" barrels.

3.8mm, 5.2mm, 7.5mm, 9.5mm, 10.5mm, 12.5mm, 14mm	$109 each
2.3mm, 18mm, 21mm, 25mm	$119 each

Orion Solar Filters

Catch this year's intense sunspot activity with a safe, full-aperture glass solar filter for your telescope. Sizes to fit many telescopes.

From $54.95

Orion LaserMate™ Collimator

Align your Newtonian's optics to get the best possible images. This compact laser collimator removes the guesswork, making the procedure quick and extremely precise. Just 3-1/3" long!

Only $69.95

DANGER
LASER RADIATION
CLASS IIIA LASER PRODUCT

Aluminum Accessory Cases

Rugged and classy looking. Pre-cut, cubed foam inside to fit your specific accessories. Ample room for giant eyepieces, camera body, lots of stuff!

Medium Case	$29.95
Large Case	$44.95

Orion EZ Finder™

Illuminated "red dot" in nonmagnified 9° field of view shows right where telescope is pointed. Adjustable brightness. Attaches to any telescope.

$39.95

Planetary Filter Set

These vat-dyed glass color filters bring out fascinating surface details on the planets and Moon.

Set of four $44.95

New!

Shorty-Plus™ 3-Element 2x Barlow

Just 2-3/4" long, Shorty-Plus has air-spaced, three-element apochromatic design and fully multi-coated optics for highest quality power-boosting performance.

$64.95

Padded Scope Cases

Protect your investment with a padded, polyester/nylon case. Strap handles for easy carrying. Many sizes.

From $29.95

BINOCULARS

TRIPOD L-ADAPTER INCLUDED!

Little Giant™ II 70mm Binocular

More compact than the original Little Giants. Big 70mm objectives reveal a plethora of nebulous clouds and stellar clusterings. Great for twilight and daytime use too. Sharp, fully multi-coated optics with BAK-4 prisms. Large, knurled center focus wheel. Classic black coarse-grain finish. Tripod L-adapter, case, and deluxe wide neck strap included. Made in Japan.

11x70	4.5° field	$259
15x70	4.0° field	$259
20x70	3.0° field	$259

New!

Intrepid™ 10x60 LE Bino

Affordable big binocular with 60mm aperture. Long 20mm eye relief, 5.3° field of view and fully coated optics. Equipped with center focus wheel and rubber armor. Carrying case and neck strap included.

$119

MegaView™ 80mm Binoculars

Premium giant binoculars with high-power optics and cross-reinforced aluminum body and sliding tripod mounting post for optimum balance. Fully multi-coated 80mm lenses with BAK-4 prisms. Long eye relief.

15x80	3.5° field	$479
20x80 WA	3.5° field	$489
30x80 WA	2.3° field	$499

New!

EXTENDABLE DEW/GLARE SHIELDS!

NEW! 12X50!

Scenix™ 50mm

Newly upgraded with BAK-4 prisms for improved images. Multi-coated optics. Metal housing, not plastic. Tripod adaptable.

7x50	7.1° field	$77.50
10x50 WA	7.0° field	$77.50
12x50 WA	6.0° field	$77.50

LONG EYE RELIEF!

UltraView™ 50mm

Extra-long 22mm eye relief makes these superb for eyeglass wearers! Fully multi-coated optics, BAK-4 prisms. New twist-lock eyecups. Tripod adaptable.

7x50	6.5° field	$159
10x50 WA	6.5° field	$159

FULLY MULTI-COATED OPTICS!

Vista™ 50mm

Featherlight High-Performance Binoculars. High-index BAK-4 prisms and fully multi-coated optics for high-fidelity images. Soft leatherette covering. Tripod adaptable.

7x50	6.0° field	$199
10x50 WA	5.3° field	$199

LONG EYE RELIEF!

Mini Giant™ Binos

Compact astro binocs that show you the light! Fully multi-coated optics, BAK-4 prisms. Long eye relief (8x56: 18mm, 9x63: 26mm). Easily hand-holdable, but also tripod adaptable.

8x56	5.8° field	$159
9x63	5.0° field	$189

TRIPOD L-ADAPTER INCLUDED!

Giant 80mm

Stunning resolution of clusters, nebulas, and lunar surface detail. Fully multi-coated optics with BAK-4 prisms. Objective bridge for added rigidity. Center focus. Tripod L-adapter included. Long 15mm-16mm eye relief.

11x80	4.5° field	$388
16x80	3.5° field	$388
20x80	3.5° field	$388

ORION
TELESCOPES & BINOCULARS
P.O. BOX 1815-S, SANTA CRUZ, CA 95061

telescope.com

ORION
AstroView™ 120
The Long & Short of It
telescope.com

FREE 100-Page Catalog
Call (800) 447-1001

MasterCard · NOVUS · VISA

When ordering, mention key code UMS

on the road with John Dobson

For nearly 60 years, sharing the universe has been his mission.

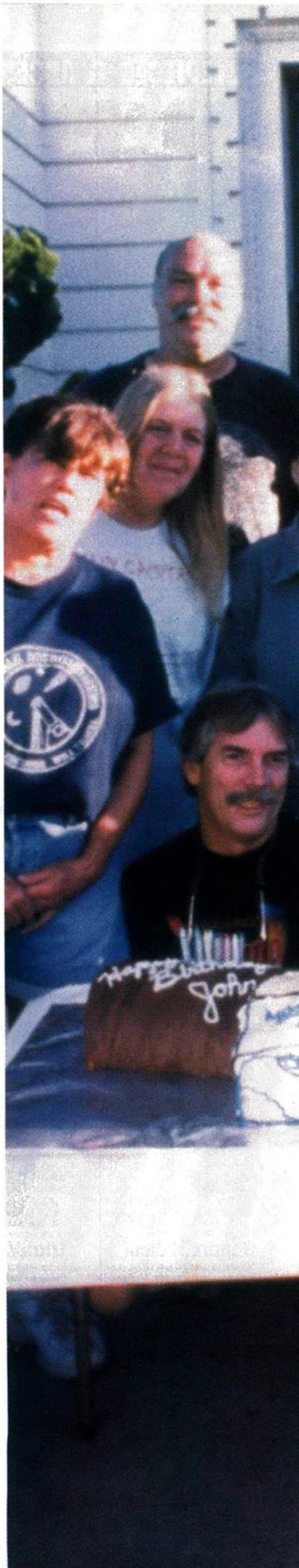
by Rosemary Sullivant
Photographs by Raleigh Souther

Looking for stars at the Griffith Observatory can be confusing. True, spotting stars is what observatories do, of course, but this is Los Angeles. The Hollywood sign is clearly visible on the hills off the east. Some people in this town keep track of movie stars they've seen like Audubon society members list birds.

On this warm Saturday in September, however, the star of the day was clearly John Dobson, astronomer to the world, whose 85th birthday was being celebrated on the observatory's front lawn, a party that has become a popular annual event. The Sidewalk Astronomers, a unique street-corner observing club of which Dobson is both a founding member and philosophical leader, threw the birthday bash and, in their characteristically egalitarian way, invited everyone to come.

It didn't matter if you knew the guest of honor or not. The party was just the way Dobson wants the world of astronomy to be — open to everyone, no one excluded. The telescopes he

John Dobson often celebrates his birthday with guests at an open party hosted by the Los Angeles Sidewalk Astronomers at Griffith Observatory.



SIDEWALK
STRONOMERS

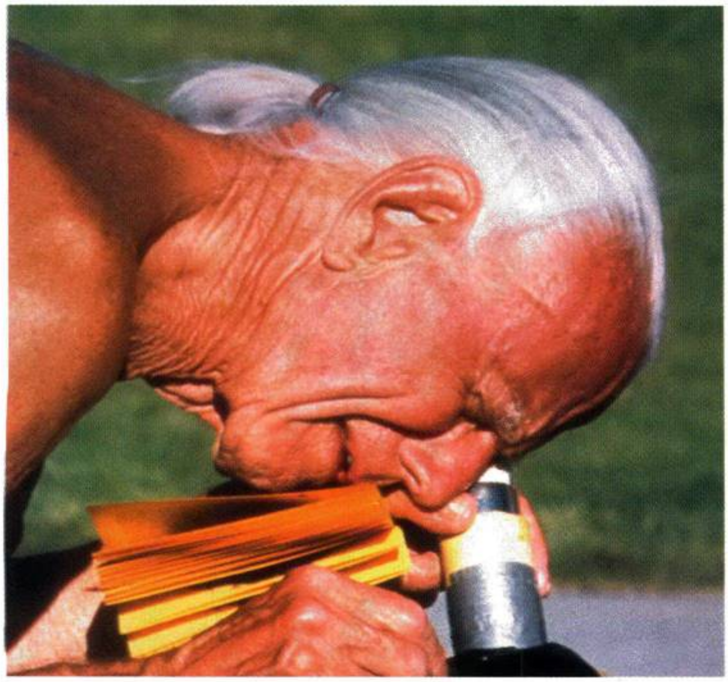
designed and that bear his name reflect the same philosophy — available to anyone who is interested, made easily from inexpensive materials with help and encouragement cheerfully provided by other astronomers.

The birthday party happily included tourists with cameras, parents with babies in strollers, teenagers in baggy pants, and astronomers of all types. They strolled past an array of Dobsonian telescopes displayed in the grass and chatted with astronomers polishing lenses and building telescope mounts under awnings set up to provide a little shade. The idea was clear: out with the mystic of telescopes and fancy equipment, and in with the mysteries of the universe.

Dobson, the birthday boy himself, was busy pointing out another star. "Come and see the sun," he called out to anyone within earshot. His style is a cross between an evangelical missionary and a Bourbon Street barker.

Standing by a solar telescope, he had already attracted a small group of onlookers. The children, especially, were obviously dying to find out what was going on, but warily eyed the thin, shirtless man with the gray ponytail, who invited them to step up to the odd contraption and take a look.

A few of the braver ones came forward, strained to see through the eyepiece, and became hooked. "That dark spot you see, that's a sun spot — I call it a magnetohydrodynamic zit," said Dobson to one puzzled young man. "Can you see it? It's near the edge of the sun. That spot is the size of Earth. The sun is a basketball, Earth a grape seed. That's what the rest of the world looks like."



"That black spot?" said the teenager, still unsure about what he was seeing. "That spot is not black," explained Dobson. "It is brighter than a welder's arc. See Saturn silhouetted against the sun, then you'll see dark."

The crowd was wowed.

For Dobson, the party was clearly just an excuse to do what he likes to do best: Get people — young, old, everyone — to take a look at the universe.

"People are born into a universe," says Dobson, "not just Earth. We owe them the right to see where they're born. Most people know nothing about the universe. We make telescopes so that people can see that there is something to be understood," he says. "If they don't see, they don't understand."

So how many people have been exposed to this Johnny Appleseed of astronomy? "I meet about 100,000 people a year," he says. "But often its in the middle of the night, so I don't know what they look like. I've been doing this for 30 years. I've probably gotten several million people to look through a telescope."

If Dobson has his way, several million more will have the chance before he is done. "I'm too old to retire," he says. Dobson and his friends spent the evening before the birthday party outside at Burbank Mall until 10 P.M. "Then cool air came in, but you could still see the moon. Astronomers in general are allergic to the moon, but not everybody has seen the moon."

"There are private star parties, but we do this. You have to go where the people are — national parks and shopping malls."

Dobson's journey to the California shopping mall started in Beijing, China, where he was born on September 14, 1915. His father was then teaching zoology at Beijing University. The Dobson family, including John and his three brothers, moved to the United States in 1927. They had intended San Francisco to be only a brief layover, but ended up staying there.

After mostly home schooling, Dobson enrolled at the University of California, Berkeley, in 1934. It took him until 1943 to be graduated, however, due to his broad range of interests. He earned degrees in chemistry and mathematics, after spending plenty of time on educational digressions.

Dobson checks the view through a solar telescope, determined to share good sunspots and flares with his guests.

A year later in 1944, he became a monk in a Vedanta monastery, part of the Ramakrishna religious order. At the monastery, he kept to a strict routine that began at about 5 A.M. each day and continued with meditation, worship, and study. Even while in the monastery, Dobson pursued his efforts to understand the universe. He began to make telescopes to capture a better look at the objects of the night.

By 1956 Dobson made the first of a type of telescope that will probably always carry his name — to his chagrin. (He called the invention a "sidewalk telescope.") He found a 12-inch porthole glass and asked if he could use it to make a telescope. When he finished building the scope, he used it to take a good look at the moon, and he very much liked what he saw.

It was then Dobson decided that owning a telescope meant you must share it with everyone who wants to see the sky — and even with some who don't know that they do. He remained with one monastery or another for 22 years, leaving only to devote himself to learning and sharing the sky. He would sometimes leave the monastery late at night and wander the streets, looking for innocent bystanders who might want to look at the sky through his scope. Dobson began making telescopes for others early in his monastic career, using mostly found materials. Eventually he built and gave away many telescopes. But by then, the monastery leadership had become frustrated with his absences and outside interests. Dobson was faced with expulsion and though he wanted to stay in the brotherhood, he couldn't part with his telescope passion and was finally asked to leave.

"Can you see it? It's near the edge of the sun. That spot is the size of Earth. The sun is a basketball, Earth is a grapeseed."

By 1968, Dobson and other Bay Area amateurs started the San Francisco Sidewalk Astronomers. Its reason for existing was to share the sky with the public. Members went everywhere — to street corners, parking lots, and Golden Gate Park — where they set up telescopes and invited bystanders to take a look.

At first, serious amateur astronomers criticized Dobson's telescope design. Some claimed that his building and testing techniques would be useless to serious amateur astronomers. These folks missed that Dobson wanted to make a big scope that almost everyone could use. *Astronomy* magazine's long-time editor, Richard Berry, is credited with coining the term Dobsonian telescope and popularizing Dobson's work in *Telescope Making* magazine and in *Astronomy*, when it first appeared in 1973.

Today, Dobsonian telescopes are common at all star parties. Some set aside a field just for Dob users. No longer, however, is every Dobsonian made at home. Many entrepreneurs have taken the Dobson idea and perfected it for sale. (Look for "Running with the Big Dobs" in this issue on page tk.)

Late in the afternoon of Dobson's 85th birthday party, *Astronomy* photographer Raleigh Souther called out that it was time for pictures. Dobson reluctantly put on his shirt and allowed himself to be cajoled into sitting relatively still on the observatory's steps with a crowd of well-wishers. The conversation, however, never actually stopped.

"Do we have a psychological connection to the sky?" a college teacher asked. "Ump," said Dobson. "We look, we find these lovely things.

"You need to wonder. What's the use of someone who doesn't wonder?"

"We saw you in New Mexico in 1998," said one middle-aged man with his wife, "in Albuquerque."

"I remember that we made a sun telescope to raffle off," replied Dobson, "and the woman who bought the first ticket, won. She cried when we told her it was hers."

When the formal pictures were over, the crowd members brought out their own cameras. "Mr. Dobson," said a handsome young man with his girlfriend standing shyly behind him. "My name is Eric. I just wanted to say Happy Birthday, and, may I take your picture?"

Later, a huge birthday cake appeared. Baked in the shape of a Dobsonian telescope, it was decorated with the words "Happy Birthday" and "nothing doesn't exist" — a Dobson theme — written in icing. "I'm allergic to the Big Bang," he said.

While someone cut the cake, Dobson found a bit of shade and ate a bowl of fruit.

He will certainly create a whole new batch of sky watchers wherever he goes. Before he's done, he will probably reach another million willing students. ■

Rosemary Sullivant, former managing editor of Sea Frontiers *magazine and a regular* Astronomy *contributor, is a freelance writer who lives in Los Angeles.*

Anyone can sell you a telescope.

Authorized Meade Dealer

Meade ETX-90EC
now only $495!
Meade ETX-125EC
$895
#497 Autostar
now only $99!

ETX-125EC

Hardly a day goes by that we don't get a note or E-mail message like the one reprinted on the next page, or a call that goes something like this: "Your ads are right. Dealer so and so advertises low prices – but they don't have what I want in stock, they couldn't answer *any* of my questions, and they wanted my credit card number before they'd even *talk* to me. They said if I wanted to ask questions, I should call the manufacturer . . . and then they hung up on me!"

If you want the right telescope, you need more than a camera store clerk armed with only a price list and not a clue in the world about astronomy.

What you *really* need are people who will take the time to listen to what *you* need, people who can answer your questions, people with years of experience using and selling telescopes who can help you get the most telescope for your dollar. That's exactly the kind of people you'll find at ***astronomics***.

Unlike camera stores and shopping mall gift shops, telescopes are our specialty at ***astronomics***, not just a sideline. We're a family-owned full-line telescope dealer – not just a few toy telescopes stuck off in the corner of some no-help department store, toy store, or gift shop as an afterthought. And, unlike department store clerks, we don't work on commission, so we won't try to sell you more than you need just to pad our paychecks.

We've been helping people choose the right telescope since 1979. We have the experience to help *you* pick the scope that fits your needs . . . *and your budget* . . . from the many Meade, Celestron, TeleVue, Takahashi, and Questar telescopes we stock at discount prices from $99 to $27,995.

And we can usually ship your right telescope right away, since we have over 1000 telescopes in stock!

astronomics. No hard sell. No guesswork. Just honest advice, the *right* scope, and a good price. Call us at (405) 364-0858 and find out for yourself.

We have the Meade LX90 in stock!

Meade
8" LX90
$1695

You can live the good life of big-aperture go-to fully computerized astronomy for less money than ever before with the new 8" **Meade LX90**.

The 8" LX90 SCT is only $1695, including a tripod and a go-to Autostar computer with 30,223 stars and objects in its data base.

We have been shipping LX90 scopes to delighted customers for months. We had 25 in stock and 125 on order as this was written, so chances are very good that you can get an LX90 with little or no delay. While backorders *are* possible on this hot new scope, if Meade is shipping the LX90 for a dealer to keep in stock, chances are good that we *have* it in stock.

Meade prices are about the same anywhere you call. So why order a Meade scope or accessory from a dealer who charges your credit card, then makes you wait and wait until he finally gets around to ordering what you want? Not when you can usually get the Meade you want . . . right now . . . at the right price . . . right here at ***astronomics.***

We have over 25 tons of telescopes in stock!

On average, we keep somewhere over 1000 telescopes in stock. At an average weight of 50 lbs. each, that means we usually have over 25 tons of telescopes in inventory at any given time. We don't know of many dealers – if any – who stock telescopes in those quantities . . . *no matter what they claim.* But we do. And we don't just stock telescopes in large quantities. We have literally tons of accessories, as well. Eyepieces, filters, CCD cameras and autoguiders, dew caps, Barlows, off-axis guiders, illuminated reticle eyepieces, electric focusers, T-adapters, tele-extenders, counterweights, and much more.

Free tripod and a $50 lower price on Meade's ETX-70AT!

Meade
ETX-70AT
$299
Freight additional on scope and tripod.

The Meade **ETX-70AT** 70mm go-to refractor hits a new low in pricing for a fully computerized scope . . . and a new high in value! For less than the cost of many single eyepieces alone, you can have a complete scope – with dual axis motor drives, two eyepieces, built-in go-to computer with 1471 stars and objects in its memory for pushbutton astronomy, and more! It's beginner scope, travel scope, spotting scope, and second scope for casual star gazing – all in one!

And now this Meade is an even better buy! For a limited time, not only has its price been cut by $50, but you get a $99.95 retail adjustable height tripod as a no-charge bonus when you buy!

A baby light bucket for summer viewing . . . only $159⁹⁵.

The **Bushnell Voyager** 4.5" tabletop rich field reflector gives you a wide field of view, plus all the light-gathering power you can get from a tabletop telescope.

4.5" Voyager
$159⁹⁵

Comes with shoulder strap, two eyepieces for 19x and 100x, and a 3-leg tabletop base that also mounts on any photo tripod for use in the field. The Voyager is a good scope for the beginning astronomer, as well as a great travel scope for the more experienced observer.

$100 lower price on Meade ETX-90EC!

Meade ETX-90EC
now only $495!

Not only is the best-selling **Meade ETX-90EC** priced $100 lower than last year, but its companion **#497 Autostar** computer has dropped by $50 as well! The **ETX-90EC** is in stock for immediate shipment, as are the **ETX-125EC** 5" Maksutov-Cassegrain and the **ETX-70AT** computerized go-to refractor. With our large Meade inventory, you don't have to wait to get an ETX from ***astronomics.***

And we don't just have ETX scopes in stock. We have Autostar computers, cases, tripods, eyepieces, electric focusers, filters, camera adapters, and more. If it's any of the Meade ETX scopes, or an accessory for a Meade ETX – *or any Meade telescope* – chances are good that we have it in stock.

We stock Pentax XL eyepieces from $227⁵⁰.

From 5.2mm to 40mm, we stock all the Pentax wide field (55° to 65°) XL eyepieces. Each has a rotate-to-adjust-the-eye-relief eyecup, ED glass, and a long 20mm eye relief that's perfect for those who wear eyeglasses. We also stock the 8-24mm Pentax zoom.

Over 1,000,000 people a year visit our redesigned and expanded website, now with secure on-line shopping.

www.astronomics.com

3-day air shipping for the cost of shipping by ground!

We ship by UPS three-day air from our centrally-located warehouse to our East and West Coast customers for the same price as regular ground shipping (except for a few big scopes, scope cases, Dobsonians, dewshields, and a few other bulky items). No matter where you live in the 48 continental United States, your order should arrive by the third business day after we ship. UPS can't guarantee 3-day delivery in case of bad weather or during peak seasons, so UPS service guarantees do not apply to this limited time free upgrade if shipments are delayed.

Our free catalog helps you pick the right Meade, Celestron, Questar, Takahashi, or TeleVue scope.

For detailed information on individual products, visit our Web site. Or call us at (405) 364-0858, or e-mail us, for your *free* copy of our catalog AST. It covers all the scopes and accessories we stock – from Apogee, Bushnell, Canon, Celestron, JMI, Lumicon, Meade, Pentax, Questar, Rigel Systems, SBIG, Software Bisque, Takahashi, TeleVue, and more. We'll include our 8-page guide on how to pick the right scope and your discount prices on the 1000+ products we carry. (Sorry, U. S. sales only.) The catalog is yours for only the cost of a one minute phone call. The information we send will make it the most useful minute you'll ever invest in astronomy.

astronomics

Our 23rd year of friendly service, good advice, and money-saving prices.

680 SW 24th Avenue, Norman, OK 73069
Toll-Free Order Line: **(800) 422-7876**
Catalogs/Questions/Advice: **(405) 364-0858**

We'll sell you the *right* telescope.

A new 8" NexStar GPS for $2499! Turn it on and it does all the work!

8", $2499
11", $2999

Finding your way around the sky just got a lot easier. Celestron's *new* 8" **NexStar 8 GPS** computerized go-to scope at $2499 and 11" **NexStar 11 GPS** at $2999 use a built-in electronic compass and GPS (Global Positioning System) to tell them where they are in time and space, align them on the sky, and start finding over 40,000 deep sky objects for you . . . *automatically!*

You don't have to level the tube, point it north, enter your latitude and longitude or the name of the nearest big city, calculate and enter universal time, compensate for daylight savings time, or do all of the other little things that some computerized scopes must have done for *them* before they can find deep space wonders for *you*. All you have to do with a NexStar GPS is turn on the telescope. The NexStar 8 and 11 GPS do the rest.

For full details on the new NexStar 8 GPS and 11 GPS, visit our website at www.astronomics.com.

New lower prices on big SBIG CCD cameras!

SBIG now has six lower-priced versions of the **ST-8E** 1534 x 1020 pixel *self-guiding* two-chip imager.

There are three enhanced blue chips to choose from. Each is available with or without antiblooming.

For spectroscopy, photometry, and critical imaging applications, Class 1 chips have no column or point defects.

Class 2 chips have no column defects and a limited number of point and cluster defects. This is an upgrade of the former ST-8E that's priced $1355 lower than the previous models! Class 2 chips are designed for most scientific applications and excellent imaging.

Class 3 chips allow for some column, point, and cluster defects. These can be eliminated by the software for very good astronomical imaging (although with somewhat restricted scientific use). The price is $1500 below competitive cameras with a similar size chip.

We stock almost all Apogee LISÄÄ, Meade, and SBIG CCD cameras and autoguiders. We also carry a wide range of CCD accessories – flip mirrors, off-axis guiders, color filter wheels, image processing software, and more. Our large inventory means the chances are good you won't have to wait to get the camera or accessory of your choice. Here are the SBIG cameras we keep in stock and their prices.

ST-5C track/accumulate camera	895^{00}
ST-237A track/accumulate camera	1195^{00}
ST-7E self-guiding camera, Class 1	2650^{00}
ST-8E self-guiding camera, Class 1	7350^{00}
ST-8E self-guiding camera, Class 2	5995^{00}
ST-8E self-guiding camera, Class 3	4995^{00}
ST-9E self-guiding camera, Class 1	3950^{00}
ST-10E self-guiding camera, Class 2	7695^{00}
ST-1001E large format track/accumulate	6595^{00}
STV digital video camera/guider	1850^{00}
STVD digital video w/LCD screen	2250^{00}

Half-price observing books!

Stars & Galaxies

We bought almost 4000 observing books from Astronomy at some very special prices. We're passing our savings on to you, pricing them as low as 50% off retail.

Beginner's Guide to Amateur Astronomy 166 page softbound, is a great starter, reg. $14.95	$\$9^{95}$
Galaxies & The Universe 112 page softbound, helps you find hundreds of galaxies, reg. $19.95	$\$9^{95}$
Stars & Galaxies 200 page hardbound, observe 344 of the best deep sky objects, reg. $29.95	$\$14^{95}$
Universe From Your Backyard 188 page hardbound, observe 690 deep sky objects, reg. $29.95	$\$14^{95}$

Takahashi – another name for premium optics.

While many people swear *at* the long delivery times quoted by some premium refractor manufacturers, most knowledgeable astronomers swear *by* the unsurpassed optical quality and fast delivery of the Takahashi apochromatic refractors we keep in stock.

From the 2.4" **FS-60C** OTA at $829 to the 6" **FS-152** OTA at $8999, we stock Takahashi fluorite apochromatic doublet refractors, mounts, and accessories – so we can deliver scopes *fast*.

Takahashi FSQ-106N OTA (4" f/5), **$3475**, on an EM-2 mount, **$2229**. Also shown is the FS-102 4" f/8 OTA, **$2349** w/o finderscope.

Why wait for 1-3 *years* to get your apo refractor or mount from another manufacturer? You can be usually be viewing through a superb Takahashi apo only a few short days after you order from us. We can also special order larger scopes with 1-3 month delivery times.

We stock complete Takahashi scopes on mounts, as well as apochromatic optical tubes for use on your own mount.

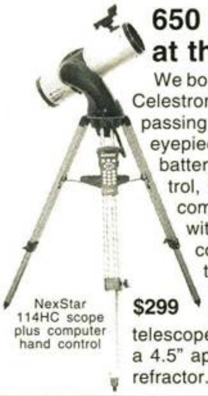
Takahashi FCL-90 ***Sky 90*** OTA (3.5" f/5.6), shown with dew shield retracted, **$2279**

A very hot Takahashi is the unique **FCL-90 *Sky 90*** 90mm f/5.6 refractor. With its self-storing dew shield retracted, as shown above, this remarkable telescope is less than 14" long! It makes a great traveller scope that you can stow away anywhere – *and it's available!*

We also stock the 22" long Takahashi **FSQ-106N** 4" 4-element f/5 dual fluorite astrograph apo refractor OTA. It's another great travelling scope.

If you want premium optics, and you want them *now*, the first name you should think of is Takahashi. The second name should be . . . ***astronomics***.

650 go-to Celestron scopes at their lowest prices ever!



NexStar 114HC scope plus computer hand control

$299

NexStar 80HC scope plus computer hand control

$269

We bought over 650 of these go-to computerized Celestron NexStar scopes at great prices, and we're passing our savings on to you. You get two 1.25" eyepieces, a red dot Star Pointer finder, dual battery-operated motor drives with hand control, software to control the scope from a computer, an adjustable height metal tripod with accessory tray, *and* a separate go-to computer hand control. Both are so sensationally easy to use that you'll be observing in minutes. A review in *Astronomy* said, "What fun to press "M31" on the hand control, then watch as the Andromeda Galaxy slides into the field of view! . . . a great telescope for someone as young as 12 or 13." The **NexStar 114**, left, is a 4.5" aperture f/9 reflector. The **NexStar 80**, right, is an 80mm f/5 refractor. Both make computerized astronomy amazingly affordable.

Buy and sell your used telescopes and accessories through the *free* classified ads at www.astrofieds.com

An 8" go-to for only $1499? Amazing!

NexStar 8

$1499

The **Celestron NexStar 8** go-to 8" SCT has just dropped in price by a big $200! You get an adjustable height tripod, Starbright multicoated optics, Star Pointer finder, 40mm Plössl eyepiece, and a computer with 18,000+ objects in its memory. It's enough scope to keep you busy and happy observing for the rest of your life – at its lowest price ever!

A lower price for the NexStar 5 . . . and a $149 tripod for free, too!

You now get a $149 value NexStar adjustable height aluminum tripod and wedge *for free* when you buy a **Celestron NexStar 5** go-to 5" Schmidt-Cassegrain. Not only do you get a free tripod, but the new $1149 price is Celestron's lowest ever for a 5" go-to scope!

Fuji astro binoculars!

Comet Hyakutake, among others, was discovered with big 150mm Fujinon binoculars. There's no guarantee that you will discover a new comet with a 10 x 70mm or 16 x 70mm Fujinon FMT-SX binocular, but we can guarantee that the 70mm Fujinons are built to the same premium optical quality standards as the big Fujis. For pricing and full details, see our newly redesigned and expanded website at **www.astronomics.com**.

> Just a quick note to thank you for the "special delivery" service I received recently. While passing through OK on our way to FL, we intended to stop by to physically pick up a pair of binoculars. Unfortunately, we got lost and arrived after closing. A phone call the next day facilitated an overnight delivery to our FL destination. Everyone was so helpful, the binoculars were there on our arrival, and at a great price! I've really enjoyed using them , and do want to express my thanks for the extra-special customer service.

Customer Quote of the Month #114

24-Hour FAX line: (405) 447-3337 Our e-mail address: questions@astronomics.com
Our multiple award-winning Internet address: www.astronomics.com

Our phone lines are open 10 to 6 CST, Monday thru Friday, and most Saturdays from 12 to 5.
Mastercard, Visa, Discover, American Express. U. S. sales *only*.

No credit card surcharge. $6.95 minimum freight. All returns less freight. Restocking fees apply to returns for credit and to merchandise returned used or damaged.

WHO LET THE DOBS OUT?

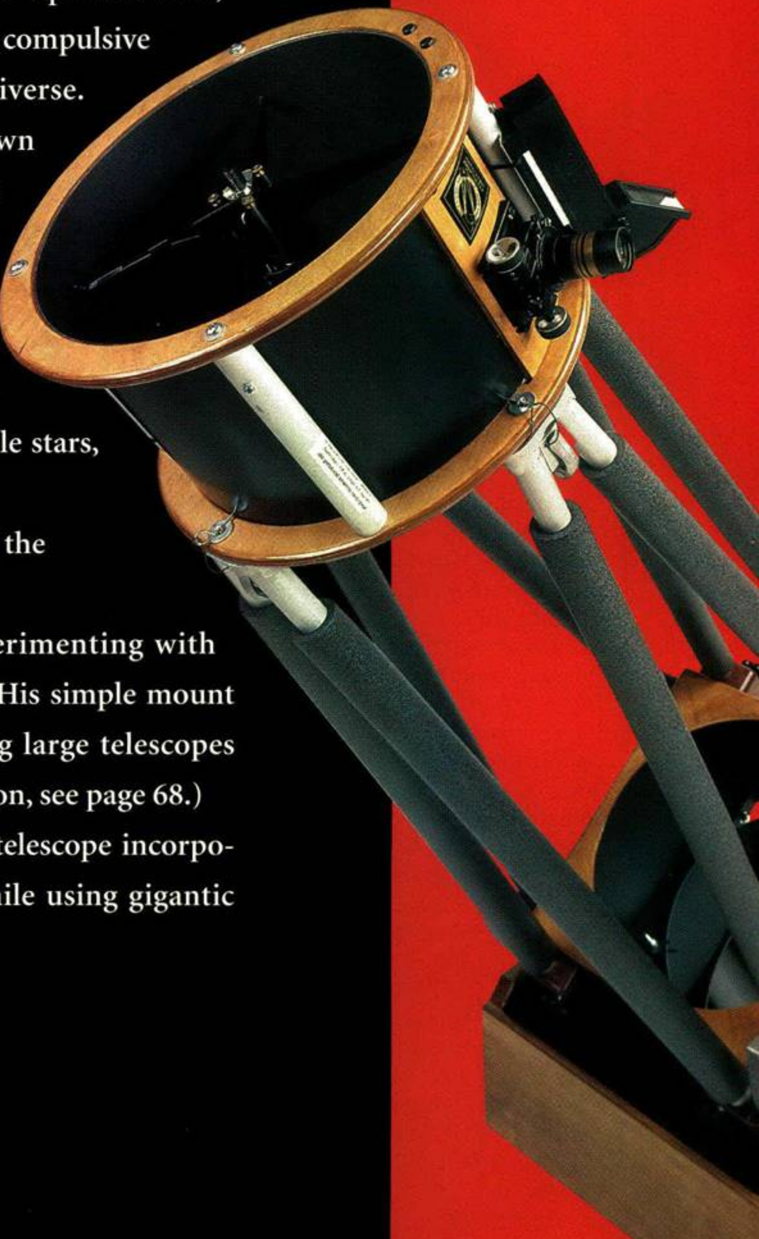
Dobsonian-style telescopes fetch deep-sky and planetary treats that welcome observers.

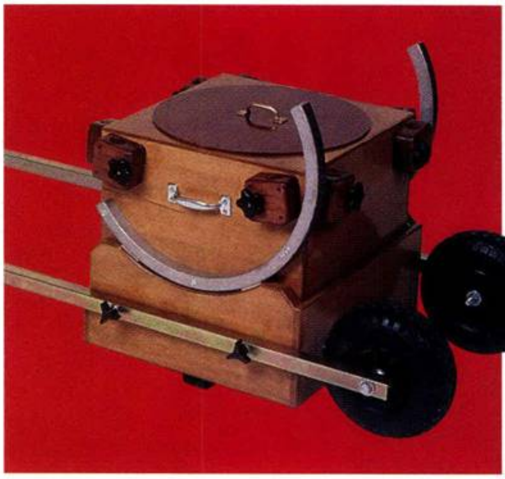
by Phil Harrington

Deep-sky observers are undoubtedly familiar with "aperture fever," a contagious astronomical affliction that causes a compulsive desire to probe deeper and deeper into the universe. Symptoms include an overpowering need to own and use ever-larger telescopes in the quest for the ultimate observing experience. Decades ago, when deep-sky aficionados began turning their attention to closer objects, they found that the optics in larger-aperture scopes available at the time delivered inadequate views of planets, double stars, and the moon.

No cure exists for aperture fever, but some of the first treatments evolved in the late 1960s when amateur astronomer John Dobson began experimenting with large, thin mirrors in San Francisco, California. His simple mount design helped quench aperture fever by making large telescopes affordable. (For an in-depth profile of John Dobson, see page 68.)

Forever named after its creator, a Dobsonian telescope incorporates the Newtonian reflector optical design while using gigantic mirrors on an easy-to-rotate mount.





Obsession's detachable wheelbarrow apparatus — a standard option — facilitates movement of the mirror box (66 lbs.) as well as the fully-assembled, 102-pound scope. Cast metal semicircular side bearings lined with Teflon pads create a smooth motion in altitude and azimuth.

Think of Dobsonian telescopes — affectionately referred to by their owners as "Dobs" — as reflectors on steroids. They're the big, friendly dogs of observing that greet their owners with a visual tongue wash.

At first, most Dobs were homemade. But by the early 1980s, telescope companies realized that not all observers had the time or know-how to build their own. Astronomers hungered for a store-bought Dob with sturdy construction and high-quality optics.

The first commercial Dobs were made by Coulter Optical Company. About five years later, Obsession Telescopes introduced a low-riding, truss-tube model that included higher-quality optics. Today, Obsession Telescopes offers five Dobs outfitted with 15- to 30-inch apertures.

Discovery Telescopes, Inc., is another contender in the premium Dob market. It manufactures three f/5 Dobsonians with apertures of 12.5 inches, 15 inches, and 17.5 inches.

While other companies also manufacture large Dobsonians, only two participated in this product review.

I tested the Obsession 15-inch (f/4.5) and Discovery's 12.5-inch Truss Design Reflector.

Design Similarities

Both companies' designs feature a primary mirror residing in a box outfitted with semicircular, adjustable bearings on either side. Foam-covered tubes attach the low-set mirror box to the upper assembly. Standard equipment for the Obsession 15-inch includes a 2" DX-3 Crayford focuser from Jim's Mobile, Inc. (JMI). The instrument I tested also included the following options: a JMI DX-1 focuser, a Telrad 1x unity finder and a light shroud, as well as the (standard) wheelbarrow apparatus for moving the telescope around. I rate the shroud as the most valuable option.

A light shroud is standard with the Discovery 12.5-inch Truss Telescope — as is the JMI DX-3 focuser, a carrying bag for the truss tubes, and 10mm and 25mm Plössl eyepieces. You'll get to choose from either a Telrad finder or 7x50 finderscope. Although the wheelbarrow handles are sold separately, your back will thank you for splurging.

Constructed of high-quality Apple-Ply plywood, famous for its strength, finish, and tiny end grain, both telescopes are asthetically pleasing. Their noteworthy woodworking is finished with a fine stain as well as a clear polyurethane coat.

In order to facilitate optical alignment with collimation tools, both scopes feature a white ring (akin to those used to reinforce looseleaf paper) at the exact centers of their primary mirrors. These "targets" make checking the alignment much easier and more precise. Obsession goes an extra measure by also marking the center of the secondary mirror with a small dot — which proves very useful, since a misaligned diagonal mirror diminishes the quality of the views.

Although these telescopes look very similar at first, their designs differ somewhat. For instance, the side bearings on the Obsession are larger (and, therefore, a bit more stable) and made from cast metal; Discovery's side bearings are wooden.

The bearing surfaces on both models mate Teflon pads with Ebony Star Formica-brand countertop material, which creates a smooth motion when swinging the telescope in altitude or azimuth.

Discovery 12.5-inch f/5 Truss Design Reflector

List price: $1,999
Optional but recommended:
Wheelbarrow handles: $119
Pancake fan, 9-volt: $39
Kydex light shield: $49
Specifications:
Focal length: 62.5"
Eyepiece height @ zenith: 65"
Diagonal mirror, minor axis: 2.60"
Upper cage diameter: 17"
Upper cage weight: 11 lbs.
Truss tubes length: 42"
Mirror box dimensions: 16"x16"x12.5"
Mirror box weight: 49 lbs.
Base dimensions: 17.25"x17.25"x15"
Base weight: 14 lbs.
Bearing Diameter: 12.5"
Total Weight: 80 lbs.

Discovery Telescopes, Inc.
615 South Tremont Street
Oceanside, California 92054
Phone: (877) 523-4400
(760) 967-6598
Fax: (760) 967-6798
http://www.discovery-telescopes.com

Obsession 15-inch f/4.5 Telescope

List price: $3,245
Optional but recommended:
JMI DX-1 focuser: $125
Telrad 1x unity finder: $45
Light shroud: $129
Specifications:
Focal length: 67.5"
Eyepiece height @ zenith: 66"
Diagonal mirror, minor axis: 2.60"
Upper cage diameter: 19"
Upper cage weight: 11 lbs.
Truss tube length: 45"
Mirror box dimensions: 17.75"x17.75"x14.5"
Mirror box weight: 66 lbs.
Base dimensions: 19"x20.5"x11"
Base weight: 21 lbs.
Bearing diameter: 20.63"
Total weight: 102 lbs.

Obsession Telescopes
P.O. Box 804W
Lake Mills, Wisconsin 53551
Phone/fax: (920) 648-2328
http://www.globaldialog.com/~obsessiontscp/OBHP.html

Simple Assembly

Assembly is a simple matter with either telescope. Obsession's eight truss tubes mount on the outside of the mirror box, while Discovery's tubes mount inside the box. It's a matter of user preference. Tubes mounted on the outside make the mirror box as small as possible, facilitating transport and storage. Exterior knobs also ease set-up and tear-down of the telescope.

Likewise, Obsession's upper truss tubes attach with cam-lock skewers, reminiscent of quick-release bicycle hubs. This part of assembly requires bare hands — even on cold nights. But because everything you need for assembly remains attached to the telescope, this "no-tool" design is an ingenious feature for absent-minded, remote-site observers. In fact, the only way to lose Obsession hardware is to lose the telescope.

Unlike the Obsession's captive hardware, the Discovery knobs are loose, but the truss tubes come in preassembled pairs — a unique foresight that saves time. The end brackets slip over threaded studs on both the mirror box and upper assembly and screw into place. However, turning the knobs in the cramped space near the mirror can be difficult — and nearly impossible while wearing gloves.

Mirror Mounts

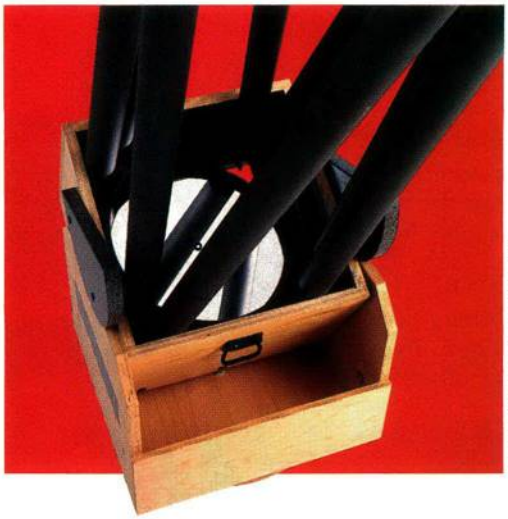
I was especially impressed with the similar, hand-adjustable diagonal mirror mounts on these Dobs. Discovery and Obsession scopes allow users to adjust the diagonal mirror mounts with small, spring-loaded thumbscrews — no tools required. The long thumbscrews on the Obsession are very convenient, even for someone with large hands.

Obsession's design requires the owner to place the primary mirror in a sling-style mount. An open-mirror style, including the built-in 12-volt pancake fan, aids in quick thermal stabilization of the mirror. This mirror can be easily removed, if necessary.

Silicone adhesive secures Discovery's primary mirror in its cell. This type of adhesive sometimes makes removing the mirror (for cleaning or recoating) a major undertaking. But the open back of the cell allows effective air flow for optical cooling and stabilization. An optional 9-volt fan accelerates this process.

Outstanding Optics

While Discover and Obsession share mirror stabilization techniques, they differ as far as optics are concerned. Discovery's Pyrex mirrors are made in the company's own factory. Its primary and secondary mirrors deliver about 94 percent reflectivity, compared to the typical 89 percent found on standard aluminized mirror coatings.



Astronomy: Bill Zuback and Jim Forbes

Discovery's truss tubes come in pre-assembled pairs, a unique design that saves assembly time. Its 12.5-inch Pyrex mirror delivers brighter images thanks to about 94 percent reflectivity — much better than mirrors coated with standard aluminizing (89 percent). Solid side bearings guide the telescope through different viewing positions.

Aperture size determines the origin of Obsession's Pyrex mirrors. Nova Optics, Torus, Galaxy, and Pegasus are among its vendors. All diagonal mirrors on Obsession scopes are coated with "Endurobright," a non-aluminum dielectric coating, which the manufacturer claims has 99 percent reflectivity. Enhanced coatings for primary mirrors are available at extra cost.

Performance Testing

I couldn't directly compare telescopes with different apertures, but I did draw some general conclusions. Obsession's Nova optics are superb; Discovery's mirrors are equally impressive. The star test, an extremely sensitive check of optical acuity, compares a star image on one side of focus to the other. Both scopes tested very close to textbook perfect.

The edge-on spindle galaxy, NGC 4565 (in Coma Berenices) clearly showed off its central bulge and distinctive, dark rift. I saw galaxies as faint as magnitude 14.5 with the Obsession; Discovery's slightly smaller aperture revealed 14th-magnitude galaxies.

And talk about colors! Prepare to be dazzled. These Dobs excelled at showing the true colors of Jupiter and Saturn. Jupiter's belts revealed some wonderfully fine structure. Cassini's Division looked like a pencil-thin line drawn completely around Saturn's rings.

Neither Dob is perfect, however. Heavy eyepieces may cause balancing problems.

Decisions, Decisions

Whichever you choose, these Dobs fetch excellent celestial visions of distant galaxies or familiar planets. And if these Dobs had tails, they'd wag 'em.

So feed your aperture fever. Let your Dob out tonight. ■

Phil Harrington's Star Ware *is available through bookstores as well as directly from his website at: http://www.philharrington.net.*

Observing opportunities abound this month. In many states across the nation, as well as Canada and the United Kingdom, public star parties are being held to encourage your participation in, and increase your knowledge of, this fascinating hobby.

If you are unable to attend one of the events listed here, contact your local astronomy club to inquire about activities taking place in your area. A listing of astronomy clubs can be found at the *Astronomy* website, http://www.astronomy.com.

FIRST FRIDAY OF EACH MONTH

Far Out Fridays

Adler Planetarium and Astronomy Museum, Chicago, Illinois. 5–10 P.M. Telescope viewing, unlimited shows in the Sky Theater and StarRider Theater, lectures by Adler astronomers, and more. Contact (312) 922–STAR; website, http://www.adlerplanetarium.org.

SEPTEMBER 8

United Astronomy Clubs of New Jersey Symposium

Jenny Jump State Forest, Hope, New Jersey. 1:30–11 P.M. For more information, contact Barry Malpas, (908) 755–6932; e-mail, njastro@erols.com; website, http://users.erols.com/njastro, under Public Events.

SEPTEMBER 12–19

Alberta Star Party

Caroline, Alberta, Canada. For more information, contact Rick and Carol Weis, 4612 17th Avenue N.W., Calgary, Alberta, T3B 0P3; (403) 286–4347; e-mail, rickcarolweis@home.com.

SEPTEMBER 13–15

CalStar

Lake San Antonio, California. Hosted by the San Jose Astronomical Association. Star party with observing only; no vendors or lectures. Contact Jim Van Nuland, 3509 Calico Ave., San Jose, CA 95124; (408) 371–1307 or Mark Wagner, e-mail, calstar2001@resource-intl.com; website, http://www.sjaa.net/calstar2001.html.

Marty and Marcy Curran

An auroral curtain paints the evening sky over Foxpark, Wyoming.

SEPTEMBER 13–16

Peach State Star Gaze

Indian Springs State Park, near Jackson, Georgia. Pre-registration required; no walk-ins. Contact Ken Poshedly, 1741 Bruckner Court, Snellville, GA 30078–2784; (770) 979–9842; e-mail, ken.poshedly@mindspring.com; website, http://www.atlantaastronomy.

SEPTEMBER 14–15

Nightfall

Palm Canyon Resort, Borrego Springs, California. Contact Nightfall, c/o Fox and Stephens, CPAs, 8300 Utica Avenue, Suite 105, Rancho Cucamonga, CA 91730; (909) 980–6050; e-mail, rstephens@foxandstephens.com; website, http://www.rtmc-inc.org/2001nightfall.html.

SEPTEMBER 14–15

Northern Arizona Star Party

Prescott Astronomy Club, Mingus Mountain, Arizona. Contact Gary Frey, P.O. Box 1114, Mayer, AZ 86333; (928) 632–7355; e-mail, gfreynpo@mindspring.com; website, http://www.pacorg.net.

SEPTEMBER 14–16

Black Forest Star Party

Cherry Springs State Park, Potter County, Pennsylvania. Sponsored by the Central Pennsylvania Observers. Cherry Springs State Park has been designated a Dark Sky Park by the Pennsylvania Department of Conservation and Natural Resources. For more information, contact CPO, P.O. Box 947, State College, PA 16801; e-mail, black-forest@pop.psu.edu; website, www.bfsp.org.

SEPTEMBER 14–16

Craters of the Moon Star Party

Craters of the Moon National Monument, near Arco, Idaho. Sponsored by the Idaho Falls Astronomical Society and the Magic Valley Astronomical Society. The star party is free but all park fees apply. Observing is at the Caves area inside the park. Camping, hiking and other recreational facilities are available. For more information, contact Jay Sneddon, (208) 736–2447. Park contact, P.O. Box 29, Arco, ID 83213; (208) 527–3257; website, http://www.nps.gov/crmo/; party website, http://www.mvas.net/members/Craters_of_the_Moon/index.html.

SEPTEMBER 14–16

Mt. Bachelor Star Party

Mt. Bachelor Ski Area, near Bend/Sunriver area, Oregon. Guest speakers include Nagin Cox from JPL/NASA and Steve White of TeleVue

Optics. For more information, contact www.mbsp.org.

SEPTEMBER 14–16

Connecticut Star Party

Colebrook, Connecticut. Pre-registration is required. Hosted by the Astronomical Society of New Haven. For more information, contact Bob Carruthers, 37 Saw Mill Drive, Wallingford, CT 06492; (203) 265–6014; e-mail, bobcarruthers@webtv.net; website, www.asnh.org.

SEPTEMBER 14–23

Equinox Skycamp

Dower House Touring Park, East Harling, Thetford, Norfolk, England. Presented by the Loughton Astronomical Society and sponsored by Broadhurst, Clarkson, and Fuller, London. Main event day is Saturday, September 15th. For details, send a large, self-addressed, stamped envelope to Mike Cook, 2 Sunset Drive, Broxhill Road, Havering-Atte-Bower, Essex, England RM4 1QL.

SEPTEMBER 15

Blue Ridge Parkway Regional Stargaze, Part I

Julian Price Park Picnic Area, on the Blue Ridge Parkway, south of Blowing Rock, North Carolina. Part II will be held Saturday, October 13, 2001. Contact, Greg Kirby, 5026 Poplar View Lane, Granite Falls, NC 28630; (828) 396–7656; e-mail, lmocvac@twave.net; website, http://users.twave.net/jafowiz/brprs.htm.

SEPTEMBER 21–23

Arunah Hill Days

Arunah Hill Natural Science Center, Cummington, Massachusetts. Free of charge. For more information, contact Steve Pielock, (413) 772–6715; e-mail, pielock@acad.umass.edu; website, www.arunah.org.

SEPTEMBER 21–23

White Sands Star Party

White Sands National Monument, Alamogordo, New Mexico. Sponsored by White Sands National Monument, the Space Center, and the Alamogordo Astronomy Club. Contact WSSP c/o Space Center Education Department, P.O. Box 5430, Alamogordo, NM 88310; (505) 437–2840 or toll-free, (877) 333–6589; e-mail, wssp@zianet.com; website http://www.zianet.com/wssp.

SEPTEMBER 22

Island Lake Star Party

Island Lake State Recreation Area, Brighton, Michigan. Hosted by the Ford Amateur Astronomy Club. For more information, contact Mike Bruno at (313) 390–5456, or e-mail Dan Kmiecik at faac1992@hotmail.com. Information can also be found at the club's website, www.boonhill.net/faac.

SEPTEMBER 22

North Texas Skywatch Star Party

Lake Mineral Wells State Park, Texas. Hosted by Lake Mineral Wells State Park, Tarleton State University, and Skywatch Products. Contact Michael Hibbs, (254) 968–9150; e-mail, hibbs@tarleton.edu; website, http://member.aol.com/Mikehibbs/Skywatch/skywatch.html.

SEPTEMBER 22

NOVAC Star Gaze

Franklin Park, Virginia, west of Washington, DC. Hosted by the Northern Virginia Astronomy Club. Hundreds of telescopes. Afternoon and evening observing, activities for the entire family, speakers, displays, dealers, swaps, and door prizes. 4 P.M.–midnight. Contact Jeff Cook, (703) 524–5333; e-mail, jeff@cookstudios.com; website, www.novac.com/gaze.

SEPTEMBER 22

Scope Out

Cincinnati Observatory Center, Cincinnati, Ohio. Contact the Cincinnati Observatory Center, 3489 Observatory Place, Cincinnati, OH 45208; (513) 321–5186; website, www.cincinnatiobservatory.org.

SEPTEMBER 22

Shreveport Star Party

Ralph A. Worley Observatory, south of Shreveport, Louisiana. Contact Cran Lucas, (318) 797–1524; e-mail, clucas@softdisk.com; website, http://www.lsus.edu/nonprofit/sbas/.

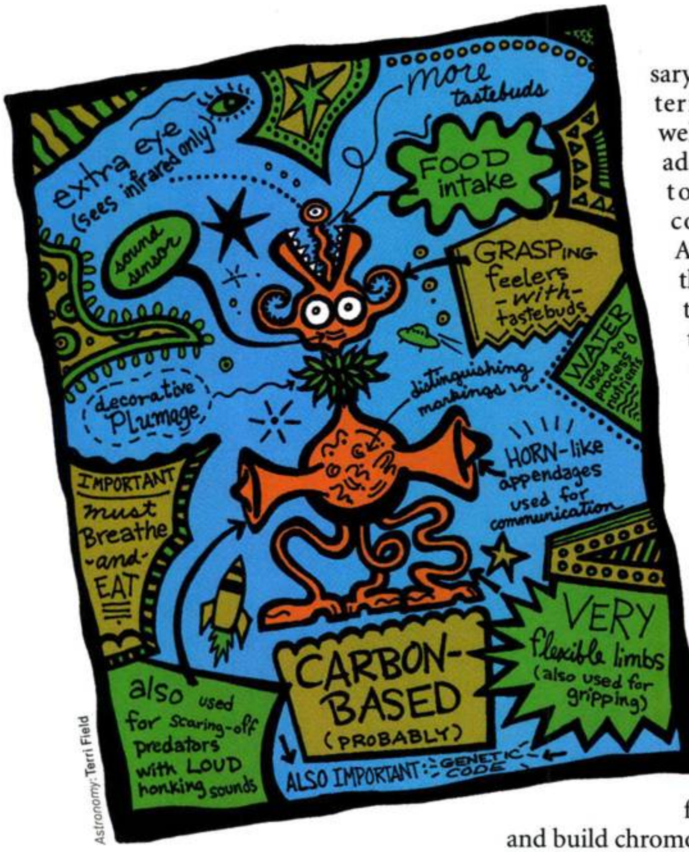
CONTACT

Please submit club announcements four months in advance to Looking Ahead, *Astronomy*, P.O. Box 1612, Waukesha, WI 53187, or to tconley@astronomy.com. Add your events to our online calendar at http://www.astronomy.com.

Astroshops.com
Your one-stop shop for telescopes & astronomy-related products

ask Astro

Extraterrestrial Life, Coordinate Converter, Got money for Mars?


more tastebuds
extra eye (sees infrared only)
FOOD intake
sound sensor
GRASPING feelers -with- tastebuds
WATER used to process nutrients
distinguishing markings
decorative Plumage
HORN-like appendages used for communication
IMPORTANT must Breathe -and- EAT
VERY flexible limbs (also used for gripping)
CARBON-BASED (PROBABLY)
also used for scaring-off predators with LOUD honking sounds
ALSO IMPORTANT: GENETIC CODE

Astronomy: Terri Field

What are the odds that extraterrestrial life will resemble earth organisms? Are scientists wasting their time looking for familiar signs of life? — *Romy Sugden, Fiji*

It's almost certain that extraterrestrial life won't look anything like what we find on Earth, and it is absolutely certain that we won't find humanoids out there (sorry, no Klingons or Vulcans).

Nonetheless, nature places a few basic constraints, both chemical and biological, on the formation of life in the universe. First of all, extraterrestrials (ETs) must somehow breathe and eat; otherwise they wouldn't qualify as alive. (Water and sunlight aren't necessary, since there are bacteria on Earth that do well without either.) In addition, ETs are likely to be composed of complex molecules. And since carbon is the best — in fact, it's the only — element that's also a molecular wizard of complexity, ETs could very well be carbon-based.

Life-forms also require a good solvent to process nutrients, of which water is by far the most versatile. Finally, life requires a genetic program to pass along hereditary information and nucleic acids to form the double helix and build chromosomes.

Astronomers are looking for Earth-like organisms for two reasons. One is that there is a high probability that life elsewhere will be carbon-based and use water as a solvent. Another is that Earth-like life will be the easiest to recognize, even if it hasn't evolved to the point of intelligence or technology.

To address these and further questions, NASA recently formed an Astrobiology Institute, headquartered at the Ames Research Center in Mountain View, California. If young readers out there find this issue compelling, consider pursuing astrobiology — a new discipline that could hit pay dirt during your lifetime. — *Athena Andreadis, Harvard Medical School, author of* To Seek Out New Life: The Biology of Star Trek *(Crown Publishing Group, 1998)*

We have several astronomy books that list right ascension and declination in epoch 1950 coordinates. Where can we find a simple formula that would allow us to update epoch 1950 coordinates to epoch 2000 coordinates? — *James and Kim Zepper-Stuberg, Duluth, Minnesota*

Astronomers define the celestial position of an object beyond the solar system by referring to its right ascension (R.A.) and declination (Dec.) coordinates, which are directly analogous to Earth longitude and latitude, respectively. In fact, the celestial poles and celestial equator are simple extensions of Earth's poles and equator.

Unfortunately, this reference system is not static, but is steadily changing. Due to the cyclic 26,000-year wobble of Earth's orbital axis, called precession, all stars move slowly against the lattice of celestial coordinates. Therefore, astronomers must reference the date, or epoch, for each specified set of object coordinates. For years, astronomical references cited epoch 1950 coordinates, according to celestial positions centered on January 1, 1950.

By 1980, it became clear that celestial objects were leaving their epoch 1950 positions behind, never to return (at least, not for another 26,000 years). Today, all new astronomical references cite epoch 2000 coordinates — referring to exact positions on January 1, 2000 — and should continue to do so well into this century, until the standard will ultimately switch to epoch 2050 coordinates.

If you have epoch 1950 charts (or older), changing positions from one epoch to another is best handled by a trusted computer algorithm.

The NASA/Infrared Processing and Analysis Center Extragalactic Database (NED) home page (http://ned.ipac.caltech.edu/forms/calculator.html) maintains an excellent on-line calculator for converting coordinates from one epoch to another.

And if you're feeling ambitious, or if you prefer a more hands-on approach, you can also visit *Astronomy.com* to learn how to make your own coordinate conversions with a little patience and some simple trigonometry. — *Phil Harrington. Visit his website at http://philharrington.net.*

Are there any stars (or other celestial bodies) in the vast amount of space between galaxies? — *Guru Sonpavde, Jackson, Tennessee*

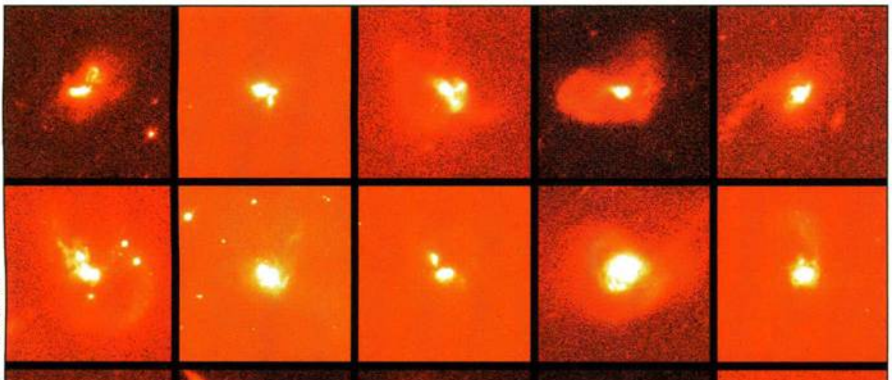
Believe it or not, stars do reside in the space between galaxies. Although the total number of such stars is not well known, we see an especially large population of them (several hundred or more per telescope field of view) in galaxy clusters where the distances between galaxies is relatively short. Most of these vagabond stars likely formed in galaxies and were later ejected as a result of gravitational interactions with other stars and gas.

Galaxies are generally found to cluster in dense associations. For example, the Milky Way Galaxy is part of a group of 35 nearby systems, called the Local Group, that are all interacting with one another. In fact, interactions between galaxies are quite common across the universe. When galaxies collide, stars may be ripped out of their orbits and strewn about as we often see in photographs of interacting galaxy pairs. These homeless stars then become part of intergalactic space.

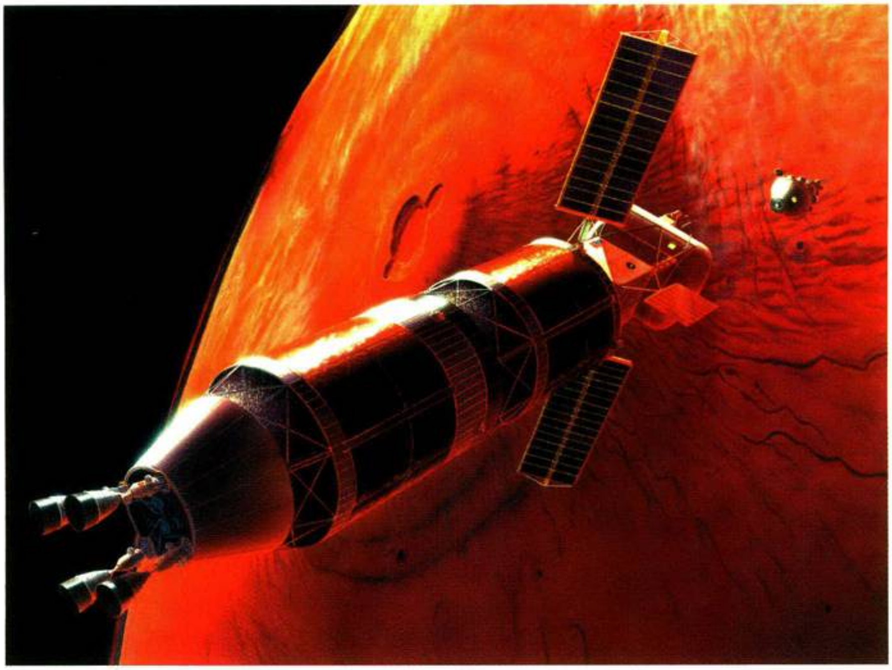
Intergalactic stars may also form as a result of galaxy collisions, when gas from each of the interacting galaxies gets compressed to the point that new stars may form in the space between the galaxies.

In addition, there is considerable evidence that large amounts of gas reside in the space between galaxies, although the nature and origin of this intergalactic gas is not fully understood. — *Chris Conselice, Space Telescope Science Institute*

Millions of stars may populate the space between galaxies, particularly in those systems where collisions are frequent.



NASA/HST/Borne/Colina/Bushouse/Lucas



NASA/Pat Rawlings

Who will be the first humans to set foot on Mars — NASA astronauts or a gang of non-smoking *Astronomy* enthusiasts?

Due to NASA's incredibly slow progress toward sending humans to Mars, I'm curious how much money per *Astronomy* reader it would take to privately fund a manned mission to Mars. — *Jim Jose, Yarmouth, Maine*

There's a wide range of opinion over how much a manned mission to the Red Planet would cost. Some estimate that it might cost as much, or more, to send space-farers to Mars as it will to complete construction on the International Space Station — about $50 billion.

On the other hand, more optimistic and budget-minded souls argue that the entire mission could be done for a little less than $1 billion.

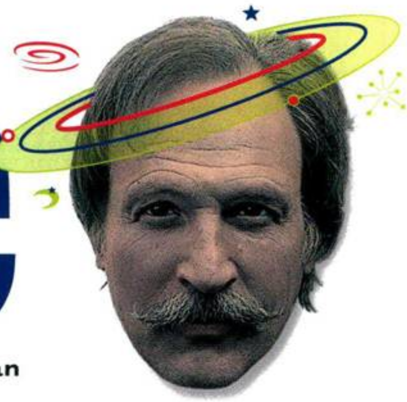
Astronomy enjoys an audience of about 300,000 faithful readers each month. (Thanks very much to all of you out there.) Unfortunately, if we accept the higher estimate, it appears that each and every one of our readers would have to sell his or her house to fund *Astronomy's* Mission to Mars. With a price tag of $50 billion, the average cost per reader would be a dizzying $160 thousand.

But hey, if we can do it for $1 billion, the cost would drop to only $3 thousand per reader. That's not so bad, is it? After all, some people spend that much on a year's supply of cigarettes. Who wants to go? Any takers? — *William Schomaker, associate editor* A

CONTACT INFO

Send your questions via e-mail to: askastro@astronomy.com; or write to: Ask Astro, P.O. Box 1612, Waukesha, WI 53187. Please tell us your full name and where you live.

strange Universe



by Bob Berman

Extra Ingredient: Artificial Color?

A friend peers at Jupiter through your scope, but seems puzzled: "Where's the Red Spot? And isn't Jupiter supposed to have orange belts?" Your picky guest may think your instrument suffers some bizarre defect, but lack of vibrant color is a common complaint at the eyepiece. Nebulae that appear intensely hued in photographs now look ghostly white or sickly greenish. Textbook images of orange-cored galaxies with blue spiral arms are replaced with grays. Fancy constellation posters present the sky in a carnival of colors. Capella is depicted as yellow, Pollux orange, Antares red.

And celestial handbooks echo those same descriptions. Advanced texts agree: "Spectral class G stars are yellow, M-class stars are red." It's unanimous. There's just one problem: This is not what you see when gazing at the heavens.

Colors are out there, all right. But — call the Better Business Bureau — they're very different than advertised. Take the case of red giants. A 1998 *Astronomy* magazine article on color-curiosities provoked debates about such stars, so this past April I asked five observers to make comparisons with a standard color chart, a 5-inch Schmidt-Cassegrain scope and unaided eyesight. Because the type of illumination influences the hues on color wheels, krypton and fluorescent lamps were used separately and in combination.

Everyone agreed that Betelgeuse was the reddest of the night's bright stars, an observation that dovetails with its listed color index of 1.85. (Also called "B–V magnitude," the color index reports brightness differences through specific filters to yield a numerical color rating).

Of the 300 stars brighter than magnitude 3.5, Betelgeuse has the reddest color index, with Antares close behind. Yet our panel found that Betelgeuse not only didn't match any tint of red on the color charts, it wasn't orange either, but yellow-orange. K-type stars Arcturus and Alphard matched up with yellow. Capella was pure white, not even "warm" enough to qualify as eggshell on a separate paint chart. And even the most obvious stellar tints are pastels — highly diluted with white.

Still, there is one way to see rich color (other than the spurious red of celestial objects viewed through low and especially humid air). Stars flash various parts of their multicolored spectra when twinkling strongly. By displaying just one section of their spectrum for an instant, the whitening effect of color-combining is momentarily eliminated; various splendid hues flicker randomly. Few amateurs deliberately focus instruments on a bright, scintillating star, but ex-hippies should know that the wild twinkling that accompanies poor seeing provides the only opportunity to experience a psychedelic parade of vivid color through the eyepiece.

We then checked out Mu Cephei. This fourth-magnitude beauty is one of the reddest naked-eye stars in the northern heavens (color index 2.23, bested only by fainter Y Canum Venaticorum's 2.55). Few people can perceive color in stars fainter than 3rd magnitude, so a telescope or binoculars is needed to bring out its tint. Herschel admiringly called it the "Garnet Star," but Mu looks telescopically like a rich orange speck of glowing coal.

Conclusion: Like idealized fashion models that one never sees in real life, the actual starry realm is different from printed depictions. Stop signs are red, but that's not the color of pumpkins or red giants; they're orange-yellow. Purported yellow stars like Capella are actually white.

Nor is there greater realism closer to home. Planetary pigments are often imaginary figments. "Enhanced-color" images pervasively published for decades have convinced most people that Mars is red and that Jupiter has a crimson "red spot" and vividly tinted belts. True-color images available from NASA show Mars as yellow-orange, Jupiter's Red Spot as pale pink, and its complex belts having very muted hues. The giant planet's overall color is warm white, just as it looks in the sky. Armed with this knowledge, you can confidently tell your complaining friend: Forget the pictures; this is the real Jupiter. And stop whining!

At least yellow, orange, and red all live on the same side of the tracks. In the imaging of nebulae, a full palette of synthetic "false color" inventiveness has become routine, with colors saturated to the max. University of Arizona astronomer Jeff Hester, co-creator of the famous vibrant "Pillars of Creation" image of the Eagle nebula, admits "in real life, this nebula would present pale, barely-there colors." Since the eye is far more sensitive to green than to red or blue at low light levels, a pale lime is usually the only visible shade at the eyepiece, just as it would be to a visiting astronaut.

Galaxies look plain vanilla white because their low surface brightnesses cannot stimulate the observer's cone-shaped color receptors, no matter what instrument is used.

But subtlety is not nuclear meltdown. Stellar pastels can still be striking, especially when contrasting hues appear side by side, which is why the wonderful double stars Albireo (Beta Cygni) and Almach (Gamma Andromedae) are so prized by astronomy's band of hunter-gatherers. If you are not put off by subtlety, hundreds more await, like the oddly tinted Cor Caroli, the brightest star in the pathetic little constellation Canes Venatici off the Big Dipper's handle.

Also consider that our eye's architecture defines and limits what we can see. Our retinas have receptors for only blue, red, and green, period. Like a TV picture tube, the eye creates all other colors by combining the impulses from those three alone. This yields some interesting consequences.

For example, we perceive yellow when our red and green receptors are both stimulated equally. Is there any way to know whether we are seeing true yellow light or merely a twin blast of red and green with no yellow at all? The answer is no.

By day, objects reflect one or more segments of the sun's spectrum. We think of grass as "being" green and figure that plants have an affinity for that tint. However, the opposite is true.

Vegetation absorbs most of the sun's radiation but rejects the green component. Plants look green because they hate that color and reflect it away.

The pink bands sometimes seen just below the violet inside a rainbow are a diffraction effect caused by lightwaves interfering with others. Unlike yellow, orange and violet light, pink does not exist independently. However, it is perceivable as a distinct entity by our visual anatomy, unlike other concoctions that cannot be processed by our eye's architecture.

Nature certainly generates additional "colors" such as greenish reds and bluish yellows, but we've never seen them. Our retina/brain system does register the differences when encountering those combinations.

Making the story more tangled, subtractive situations (mixing dyes or paints) create a different ball game than additive conditions (mixtures of light such as those that occur in stars or TV images). Each has different primaries and produce dissimilar colors when combined. You get green if you blend blue and yellow pigments but not if you blend blue and yellow light.

Our retinal hardwiring thus delivers to us a quirky but fascinating visual universe. When using your 8-inch scope, make sure that you trust your own observations above any published description, including those in this article. Revel in the true-color cosmos: While there's no way to get real reds at the eyepiece, a clear night and a good companion ensure that at least you won't get the blues. **A**

2 GREAT LOCATIONS

Penna.-POCONO MOUNTAIN OPTICS
ORDERS: 800-569-4323 • INFO: 570-842-1500

Las Vegas-POCONO WEST OPTICS
ORDERS: 800-635-3607 • INFO: 702-252-7200

POCONO GLADLY ACCEPTS: *with no surcharge*
DISCOVER NOVUS VISA MasterCard AMERICAN EXPRESS

$7.00 MINIMUM SHIPPING/UPS (in U.S.)
- Purchase Orders from Qualified Institutions Gladly Accepted
- We Purchase and Take In Trade Used Telescopes

VISIT OUR 50+ PAGE ON LINE CATALOG WITH SECURED 24 HOUR ON LINE ORDERING AT: www.PoconoScopes.com
Look for our Monthly On-Line Specials! Call or write for our printed catalog & specials.

YOUR MEADE AUTHORIZED ADVANCED PRODUCTS MAIL ORDER DEALER

Meade Dobsonians: Available in: 6"F/8, 8"F/6,10" F/4.5, 12.5" F/4.8, 16" F/4.5, optional deluxe accessory package $49.95

New Meade ETX-90/EC and ETX-125/EC-with pushbutton electronic control comes standard with dual-axis drive system W/4 dual axis speeds. Add the Meade Autostar hand control to your scope and get fully automatic go to capability to over 12,000 objects. The ETX-125/EC has 5" of Aperture & RA Finder. Available Now.
ETX-90/EC Now $495.
ETX-125/EC $895.
Original ETX-90 RA Now $435.

ALL DS SCOPES AVAILABLE

Meade LX-200 SCT's, The World Famous "GoTo" Telescope Available in 8" F/10 or F/6.3, 10" F/10 or F/6.3, 12" F/10, 16" F/10.

ACCESSORIES FOR ETX-90 RA, EC, 125EC	
#126 Barlow	$47.95
#64 T-Adapter	$34.95
#932 Image Erect Diagonal	$49.95
Hard Case for 90	$99.95
Soft Case for 90 RA & EC	$39.00
07329 #775 Hard Case for ETX-125EC	$155.00
8X25 right Angle Finder for 90	$49.95
Auto Star Hand Control for 90 &125 EC	$99.00
Equatorial Table Top Tripod (w/Hi Lat Leg)	$29.95
Equatorial Table Top Tripod (w/Hi Lat Leg) for 125 EC	$55.00
Deluxe Field Tripod	$199.00
07077#1244 El. Focus for all ETX-90's	$119.95
07078 #1247 Elect. Focuser-ETX-125EC/S.scope	$119.95
DS SERIES ACCESSORIES	
07437 #495 Autostar (hand box only)	$99.
07438 #492 Dual Motor Elect. Control System	$129.
07439 #493 Autostar, Complete System	$199.
07076 #1240 Elect. Focuser	$75.
07041 #490 Elect. Focuser	$75.
07221 #937 2" Diagonal Mirror w/.96 & 1.25" Ad	$45.
Meade 8" LX-10	**$995.**
Super Wedge	$395.
New Field Derotator for 8", 10",and 12" SCT's, and 7" Maksutov	$395.

New ETX-60 $249.&
New ETX-70 $299.
Now Available with Tripod

NEW
8" LX-90 SCT
$1695.

World Renown Series 4000"Eyepieces
Complete line in stock for immediate delivery!
NEW Meade Series 4000 8MM to 24MM Zoom Eyepiece $219.95

Tele Vue "WHEN YOU WANT THE FINEST"

We stock the entire Tele Vue line for immediate shipment. All items also on display and available for purchase and pick up at both of our showrooms.

NAGLERS 82° Apparent Field of View
Choose from 4.8 MM $175., 7 MM $220., 16 MM $310.
New Type 4 12MM Nagler $340.
Orders now being accepted for the 17MM and 22MM Type 4 Naglers
Type 5 31 Nagler $595
RADIANS 60° Apparent Field of View, 20 MM eye relief
Avail. in 3, 4, 5, 6,8, 10. 12. 14. & 18 MM $228.00
PANOPTICS 68° Apparent Field of View
15MM $210., 19MM $240., 22MM $280., 27MM (2") $330., 35MM (2") $365.

NEW TELE VUE NAGLER EYEPIECES

5 mm Nagler Type 6	$280.00
7 mm Nagler Type 6	$280.00
9 mm Nagler Type 6	$280.00
16 mm Nagler Type 5	$320.00

NEW TV-102
In Stock
$2150.

Ranger, Pronto, TV-85 in stock

CELESTRON
We carry the full line of Celestron Telescopes and Accessories
New Nexstar 4 Maksutov Now Available!

NEW NEXSTAR 5 & 8
NEW LOWER PRICES! Flawless go-to and tracking. Superb optics, very quiet. A real winner! Nexstar 5 $1149. Nexstar 8 (w/tripod) New Low Price $1499!

CELESTAR 8 DELUXE
2032 MM FL., Heavy Duty Adj. Tripod Dec Motor and Hand Control. 4 Tracking Rates and PEC Fastar Compatable. In Stock for Immediate Shipment. $1699. Celestar 8, reg. version $1099.

NEW LOWER PRICES & FREE COLOR FILTER SET

Nexstar 60	$249.00
Nexstar 80	$349.00
Nexstar 114	$439.00
Nexstar 4	$599.00

DESERT STORM COVERS
Protect your investment- Covers available for all size scopes. Manufactured with a thick mylar "heat resistant" material

4"- 6" Dobs & SCTs	$21.95
7" -8" Dobs & SCTs	$26.95
10" -13" Dobs & SCTs	$32.95
14" SCTs	$38.95
16" -18" Dobs	$44.95
20" -25" Dobs	$54.95

Dealer Inquiries Invited

ORDERING & SHOWROOM HOURS
Penna.-POCONO MOUNTAIN OPTICS
Order: 9-9 Mon.-Fri., 9-5 Sat., 12-5 Sun.
Showroom: 10-5 Mon.-Sat., 12-5 Sun.
Las Vegas-POCONO WEST OPTICS
Order: 9:30-6 Mon.-Fri., 10-5 Sat.
Showroom: 9:30-6 Mon.-Fri., 10-5 Sat.
Prices and specifications subject to change

Pocono Mountain Optics
Penna.-POCONO MOUNTAIN OPTICS
104 N P 502 Plaza, Moscow, PA 18444
FAX NO. 570-842-8364 Visit our Website at: www.PoconoScopes.com
E mail: pmo@PoconoScopes.com
ASTRONOMICAL LEAGUE

POCONO WEST OPTICS
Las Vegas-POCONO WEST OPTICS
2580 S. Decatur #3, Las Vegas, NV 89102
FAX NO. 702-252-7130 Visit our Website at: www.PoconoScopes.com
E mail: pwo@PoconoScopes.com
Mention Ad A-7
ASTRONOMICAL LEAGUE

PRODUCTS

Send Rover On Over

Make your own snazzy version of a Mars rover and simulate grand personal versions of NASA missions with these two kits from LEGO®. The LEGO MindStorms™ Robotics Invention System 1.0, Vision Command, and the Exploration Mars Expansion Kits allow anyone over 12 to create his or her own martian or extraterrestrial playground.

Developed by researchers at the Massachusetts Institute of Technology, LEGO MindStorms combines the versatility of LEGO pieces with robotic control and technology.

LEGO MINDSTORMS™
INTRUDER ALERT
VISION COMMAND™
CREATE ROBOTS THAT SEE
Ages 12+
PC REQUIRED
CD-ROM WINDOWS® 98
Cont. 141 PCS
CONSTRUCTION AND PROGRAMMING SYSTEM
ACTUAL SIZE
PC VIDEO CAMERA
• INCLUDES VISION RECOGNITION SOFTWARE
• WORKS WITH ROBOTICS INVENTION SYSTEM™
9731

A microcomputer receives signals from an infrared transmitter attached to your computer's serial port and stores programs in its memory.

Program your own LEGO configurations to conquer distant worlds. Create amazing machines with arms, landers, and rovers — and then program them to operate from your PC.

If you own a PC video camera, attach it to your rover and watch live video on your monitor as the rover explores its martian terrain.

The Robotics Invention System 1.0 has 717 LEGO pieces, software, transmitter, cables, sensors, and two motors. It uses six AA cells and one nine-volt battery (not included). Order catalog #9747; cost is $199.99.

The Mars Exploration Expansion Kit (#9736) sells for $49.99. Vision Command (#9731) has 145 pieces and is priced at $99.99.

Look for specific details on the system requirements for these LEGO kits by visiting LEGO's website at: http://www.LEGO.com. Navigate the website to the LEGO finder to MindStorms to "Contact Us"; then access technical support for exact specifications and frequently-asked questions.

Order directly from LEGO at: (800) 453-4652; or visit: http:// www.RobotStore.com; (800) 374-5764.

Astronomy®

Take another look at *Astronomy!*

Order back issues of *Astronomy* today and
rediscover astronomical history!

www.kalmbachbooks.com

For a complete listing of available back issues and featured stories,
send a business-sized SASE to Kalmbach Publishing Co., ASY Back Issues Dept.
21027 Crossroads Circle, P.O. Box 1612, Waukesha, WI 53187-1612.

Astronomy®

2383-9806

AFIL

www.camcor.com

Camera Corner

One of the largest Selections

- Telescopes • Spotting Scopes
- Binoculars • Tripods • Eye Pieces
- Accessories • Cases • Books
- Maps • Globes
- Cameras • Film
- Processing

All Name Brands Available

• Bushnell • Canon • Celestron • Fujinon • JMI • Kowa
• Leica • Meade • Nikon • Pentax • Tele Vue • SBIG • Steiner

Camera Corner

Established 1949

2273 South Church St. • Burlington, NC 27215
Voice 336-228-0251 • Fax 336-222-8011
e-mail: sky@camcor.com

800-868-2462

You've never seen anything like it!
Experience the Largest, Most Complete Optical Supermarket in the World.

Scope City Locations / Showrooms
SIMI VALLEY, CA: 730 Easy Street, (805) 522-6646
SHERMAN OAKS, CA: 14324 Ventura Blvd., (818) 789-5805
COSTA MESA, CA: 3033 S. Bristol, (714) 957-6900
SAN DIEGO, CA: 4766 Clairemont Mesa Blvd., (858) 277-6686
LAS VEGAS, NV: 4825 W. Flamingo Rd., (702) 947-2673
SAN FRANCISCO, CA: 350 Bay Street, (415) 421-8800

Save up to 45%
All Major Brands at discount prices

Buy
Sell
Trade
Service

MAIN OFFICE: 730 Easy Street,
Simi Valley, CA 93065, (805) 522-6646

Scope City / Mail Order
P.O. Box 440, Simi Valley, CA 93062
TEL: (805) 522-6670
www.scopecity.com

BOOKS

Life Beyond Earth

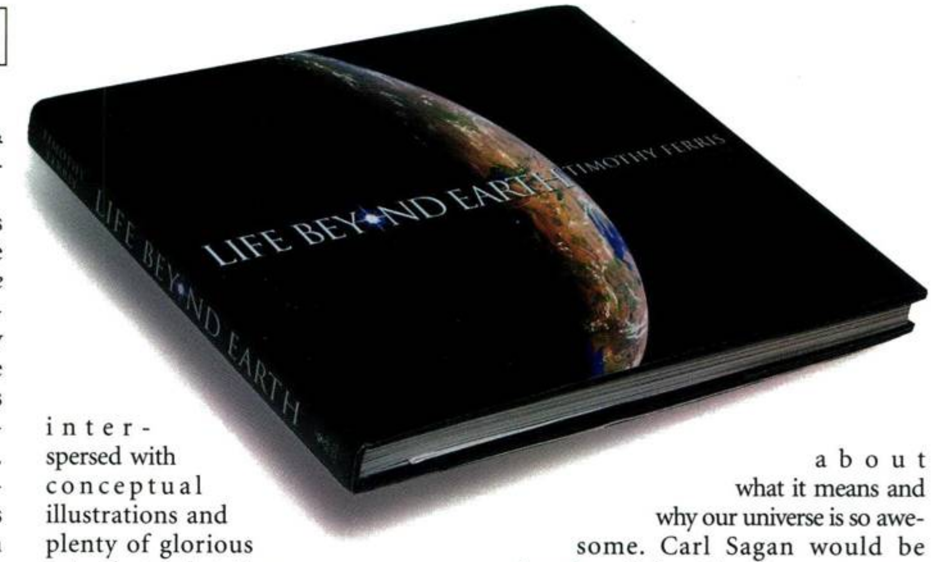
Timothy Ferris, 222 pages, Simon & Schuster, New York, 2001; ISBN 0-684-84937-2; hardcover, $40.

Anyone who treasured Carl Sagan's PBS series, "Cosmos," will recognize the imprint of Sagan throughout *Life Beyond Earth*, a new book by accomplished science journalist Timothy Ferris. Indeed, Ferris dedicates the volume to Sagan, who died five years ago after arguably doing more for science literacy than any other scientist. But *Life Beyond Earth* is no mere channeling of Sagan. Rather, it represents Ferris's distinctive angle on the question of our place in the cosmos.

Astronomers have learned much about the potential for life elsewhere since Sagan's compelling mixture of fact and fancy first aired more than two decades ago. *Life Beyond Earth*, based on a two-hour film written and narrated by Ferris for PBS, brings readers up-to-date on the quest. Most topics are familiar to regular readers of *Astronomy*: myriad planets orbiting other stars, evidence for subsurface oceans on some moons in our solar system, ongoing efforts in the Search for Extraterrestrial Intelligence (SETI) project.

The book is unabashedly optimistic about the prospect that life is abundant. Don't expect much skepticism; if you're among the great minority of people who think there may be "floating jellyfish" in the clouds of Jupiter, *Life Beyond Earth* will fire up your imagination.

This mindset extends to several experts that Ferris tapped for his project. For instance, it's hard not to raise an eyebrow when Harvard physicist Paul Horowitz declares that it's "completely impossible" for other intelligent civilizations to not exist in our galaxy.



Ferris has written many fine works of eloquent and scholarly literature, including *Coming of Age in the Milky Way* (1988). In *Life Beyond Earth*, he simply transfers his documentary into book form. The result is a blazing-fast read — although the experience is rather like looking at a set of movie storyboards. Stills from the film are interspersed with conceptual illustrations and plenty of glorious astrophotos, but they break no new ground for readers who have purchased other recent large-format astronomy volumes.

The text is spare, with perhaps 50 to 150 words per page. The words are laid out in a poetry style, leading to an odd sing-songy effect. In this case, seeing the program on television is much more visually rewarding.

The minimalistic writing is easy going, with not a jot of jargon or the hint of an equation. Some flourishes work; it's marvelous to think about the gigantic but static volcanoes on Mars as "geological gravestones." Others, such as calling Jupiter's moon Io a "palpitating bag of lava," are more strained metaphors.

Toward the end, Ferris embarks on a beautiful meditation about whether or not life is an "emergent" property of the universe — as inevitable as a storm system evolving from molecules of water and hot air. He also gives space to other voices, including biologist Norman Pace, paleontologist Stephen Jay Gould, and physicist Freeman Dyson. Their thoughts are fascinating, the stuff of spectacular dreams. But most priceless is the query posed to an extraterrestrial by a Hawaiian schoolboy: "Do you have any special abilities, like zapping people?"

Life Beyond Earth is reasonably priced and will look handsome on a family's coffee table. It's easy to imagine parents leafing through the book with their children, reading each nugget of text aloud and then talking about what it means and why our universe is so awesome. Carl Sagan would be pleased. — *Robert Irion,* Astronomy *contributing editor*

Mars: The Lure of the Red Planet

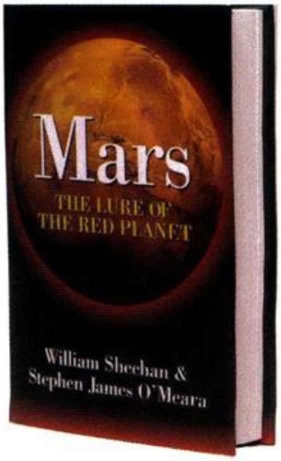
William Sheehan and Stephen James O'Meara, 350 pages, Prometheus Books, Amherst, New York, 2001; ISBN 1-57392-900-X; hardcover, $27.

Voyage to Mars: NASA's Search for Life Beyond Earth

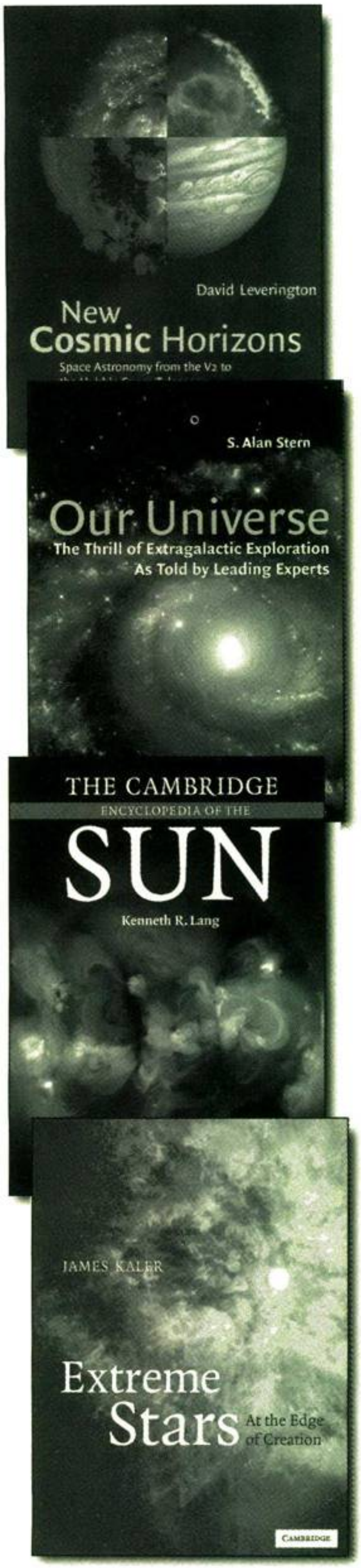
Laurence Bergreen, 355 pages, Riverhead Books, New York, 2000; ISBN 1-57322-166-X; hardcover, $27.95.

Both these books address the lure of Mars, but that's where the similarity ends. However, each book excels in different arenas. Sheehan and O'Meara present a scholarly history of observations and ideas about the Red Planet, while Laurence Bergreen describes and explains the passions of present-day martian explorers.

(continued on page 89)



Let your Imagination Soar!


David Leverington
New Cosmic Horizons
Space Astronomy from the V2 to
S. Alan Stern
Our Universe
The Thrill of Extragalactic Exploration As Told by Leading Experts
THE CAMBRIDGE ENCYCLOPEDIA OF THE
SUN
Kenneth R. Lang
JAMES KALER
Extreme Stars
At the Edge of Creation
CAMBRIDGE

New Cosmic Horizons

Space Astronomy from the V2 to the Hubble Space Telescope

David Leverington

"...thorough and clear...also well structured…the author witnessed many of the events first-hand, giving his writing authority...I recommend the book to anyone interested in space astronomy."

–*Nature*

0-521-65137-9, 520 pp, Hardback, $85.00
0-521-65833-0, 520 pp, Paperback, $29.95

Astrophotography for the Amateur

Second Edition

Michael A. Covington

"...highly recommend[ed]...to novice astrophotographers, but it is also an excellent reference for more advanced individuals....This work would also serve well in the field, as a quick reference to many of the formulas and techniques contained within."

–*Sky & Telescope*

0-521-62740-0, 346 pp, Paperback, $34.95

Our Universe

The Thrill of Extragalactic Exploration as Told by Leading Experts

S. Alan Stern, Editor

"[A] fascinating collection of essays on cosmology by nine of the most important scientists in the field."

–*Publishers Weekly.*

0-521-78330-5, 200 pp, Hardback, $54.95
0-521-78907-9, 200 pp, Paperback, $19.95

The Cambridge Encyclopedia of the Sun

Kenneth R. Lang

The fundamental, up-to-date reference on the Sun, covering everything from basic facts to detailed concepts.

0-521-78093-4, 280 pp, Hardback, $49.95

The Cambridge Dictionary of Space Technology, Second Edition

Mark Williamson

2,300 entries—700 more than the first edition—on basic concepts and advanced applications in this fast-developing field.

0-521-66077-7, 472 pp, Hardback, $39.95

Extreme Stars

At the Edge of Creation

James Kaler

Kaler explains the natures of the brightest, the largest, the hottest, and the youngest kinds of stars, and includes a selection of the strangest stars the Universe has to offer.

0-521-40262-X, 248 pp, Hardback, $34.95

Life on Other Worlds

The 20th-Century Extraterrestrial Life Debate

Steven J. Dick

Now in paperback

"Amazingly comprehensive, as well as highly entertaining."

–*Sir Arthur C. Clarke, CBE*

0-521-79912-0, 304 pp, Paperback, $15.95

Available in bookstores

CAMBRIDGE
UNIVERSITY PRESS

us.cambridge.org/astronomy

HOME-DOME®
and
PRO-DOME™

MOBILE
OBSERVATORY

Popular Astronomy Club
Rock Island, IL, HD-6S Dome

- True Rotating Dome
- 6, 10, 15ft. Diameter
- Motors & Automation
- Easy Assembly
- All Fiberglass
- Wide Slot Openings
- Complete Systems Priced from $2350

NEW - ROBO-FOCUS™
Automated Focus Driver
with temperature compensation
$375.00

Technical Innovations, Inc.
22500 Old Hundred Rd.
Barnesville, MD 20838
Ph: 301-972-8040 • Fax: 301-349-2441

FREE BROCHURE
www.homedome.com

IDENTI-VIEW™
PREMIUM GLASS SOLAR FILTERS
- **SAFE • HIGH QUALITY**
- **STRICT CONTROL STANDARDS**
- **LIMITED LIFETIME WARRANTY**

CLASS "A"
Color band - blue. Class "A" filters are made with the same premium quality polished glass and multi-alloy coating as Class "B". An additional steel alloy added to the coating process makes our Class "A" filters extremely scratch and fade resistant. Excellent for visual and photographic use. Light transmission is 1/1000th of 1%.

CLASS "B"
Color band - white. Class "B" filters are made with polished glass and multi-alloy coating. These filters offer great durability and will provide many years of service and enjoyment with normal use. Can be used visually and for photography. Light transmission is 1/1000th of 1%.

CLASS "C"
Color band - red. Class "C" filters are specifically coated to a lighter density (ND-4). They are for photographic use only. This filter is intended for use by professionals and serious hobbyists. Light transmission is 1/100th of 1%.

ORDERING INFORMATION
1. State scope brand and model number, *aperture and outside* diameter with filter class and price.
2. Make check or money order payable to J.M.B. Inc. All foreign checks must be payable through a U.S. bank.
3. Shipped free within the continental United States. All others add $5.50 Shipping and Handling per filter. Michigan residents add 6% sales tax, allow 2-3 weeks for delivery.

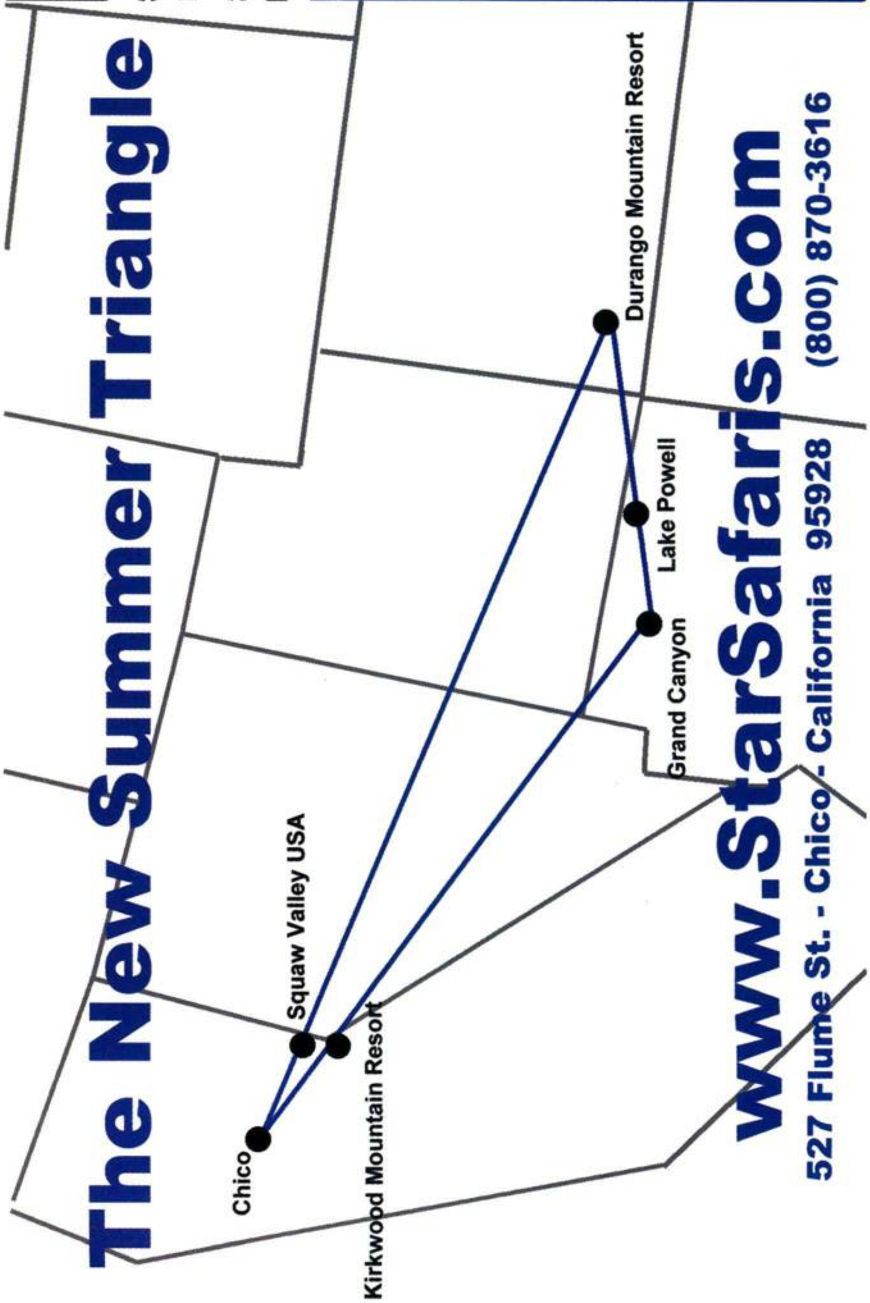
VISA **J.M.B. INC.** MasterCard
736 Oak Glen Circle • Fall Branch, TN 37656
(423) 348-8883 • FAX (423) 348-6389
"Imitated but never duplicated"

STAR SAFARIS

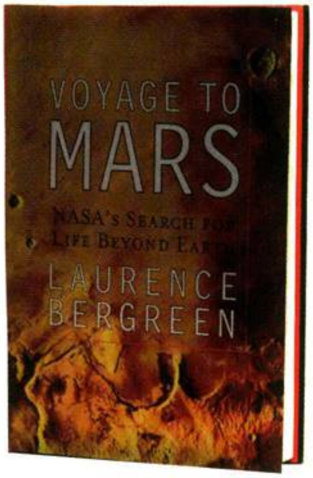
Star Safaris now offers star gazing and telescope tours at some of the southwest's darkest skies. Take your family on an introductory binocular tour or enjoy an all night observing session using one of our 30-inch JMI NTT telescopes. Don't let light pollution ruin your summer star gazing. Join Star Safaris at:

Squaw Valley
Durango Mountain Resort
Kirkwood Mountain Resort
Grand Canyon
Lake Powell

The New Summer Triangle



www.StarSafaris.com
(800) 870-3616
527 Flume St. - Chico - California 95928



Bergreen's skills as a biographer clearly lie in revealing personalities and motivations. He labels the scientists and engineers devoted to the exploration of Mars as "the world's last great explorers." Early on, Bergreen introduces planetary scientist Jim Garvin and his explorations of Mars-like terrains in Iceland, frequently revisiting Garvin's fervor for Mars throughout the book. (It could be subtitled "The Jim Garvin Chronicles.")

Bergreen also emphasizes the new generation of Mars scientists and engineers, in contrast to the Viking-era "grizzlies." For example, Bridget Landrey, an engineer on the Pathfinder mission, loves the masquerading subculture and "stretching the envelope of what technical women should be." Then there's Gil Levin — who still believes his experiment on the Viking Landers discovered life on Mars. We learn of Levin's decades-long feud with Jerry Soffen, Project Scientist for Viking, who is quoted as saying, "Scientists are after one thing: The truth. Gil is after glory."

Bergreen describes the "midsummer Martian madness" surrounding publication of the paper about ALH84001, the ancient meteorite from Mars from which evidence for fossil bacterial life has been claimed, and the bitter global controversy it fueled among scientists.

Unfortunately, *Voyage to Mars* contains some technical errors. For example, most of Iceland's population does not live below the largest glacier (and in the path of catastrophic floods like those that may have occurred on

International Dark-Sky Association

Promoting efficient lighting to reduce glare, to conserve energy, and to preserve the beauty of our night skies

To learn about *light pollution, energy waste, light trespass,* and related issues, or to join,
($30 basic membership),
call or write to the non-profit
International Dark-Sky Association,
3225 N. First Avenue
Tucson, AZ 85719-2103
(520) 293-3198 • (520) 293-3192 (fax)
http://www.darksky.org

SCOPETRONIX
QUALITY ASTRONOMY PRODUCTS
PHONE/FAX
(941)945-6763

Introducing "Digi-T"™

Digi-T mates most digital cameras with threaded lenses to ALL of the following 1.25" eyepieces:
Meade ETX, MA, Series 4000 Super Plossls, NexStar Plossls, Sirius Plossls, ScopeTronix Plossls, Series 300/400, and many MORE!

Digi-T provides the closest possible connection for the fullest possible picture!
Digi-T is secure, quick, and easy to use. Now you can even use 40mm eyepieces!
Digi-T won't raise the eyepiece like a projection adapter, no back focus problems!
Digi-T kits are available to fit most common digital cameras, video cameras too!

Mounting is easy! Simply pull off the rubber eyeguard, slip the Digi-T over the top of the eyepiece and tighten the set screws into the groove. The Digi-T will be flush with the top of your eyepiece. Now just thread on the step ring that mates it to your camera!

The best way to connect a digital camera to your telescope....bar none!

Kit:	***Each kit contains everything needed for the listed models of digital camera!***	Price:
DT1	For Nikon 800, 900, 950, 990	**59.95**
DT2	For Nikon 880	**89.95**
DT3	For Olympus 2000, 2020, 2040, 3000, 3030, 3040	**89.95**
DT4	For Cameras with a 37mm lens thread (***some*** Sony Mavicas, Sharp ViewCams, others)	**59.95**
DT5	For Olympus D450D, D460	**84.95**
DT6	For Kodak DC260, DC265, DC290	**89.95**
DT7	For Kodak DC4800	**89.95**

Your camera not listed? Additional kits are coming soon! Check our website for the newest kits.

ScopeTronix ETX & NexStar Piggy Back Camera Mounts

PB70	ETX-60/70AT....	**42.95**
PBCM	ETX-90EC/RA	**49.95**
PB125	ETX-125EC...	**64.95**
NPBACK	NexStar 5	**59.95**
NPBACK8	NexStar 8	**35.00**

WE ACCEPT:
DISCOVER
VISA
MasterCard
AMERICAN EXPRESS Cards

ScopeTronix ETX & NexStar Photo Tripod Adapters

DXTRAD	ETX Deluxe..	**69.95**
MDTRAD	ETX 1/4-20...	**32.95**
HDTRAD	ETX 3/8-16...	**38.95**
NTRAD	NexStar 3/8-16	**39.95**
N5ETX	Converts ETX Field Tripod to NexStar	**44.95**

ETX Deluxe

ScopeTronix ST Series Plössl Eyepieces

EP04	4mm ST Series Plössl	**42.95**
EP06	6mm ST Series Plössl	**42.95**
EP09	9mm ST Series Plössl	**42.95**
EP15	15mm ST Series Plössl	**42.95**
EP25	25mm ST Series Plössl	**42.95**
EP30	30mm ST Series Plössl	**52.95**
EP40	40mm ST Series Plössl	**52.95**
EPSET	Complete Set (7).......	**239.00**

ScopeTronix Dec Fix Kit™
Improves LX50 declination drive performance!
DFKA **49.95**

ScopeTronix LX90 Wedge Adapter
converts standard LX wedge to LX90
LX90WA (not for super wedge) **49.95**

ScopeTronix ETX & NexStar 4 "Field Doubler" & 1-1/4" Visual Back

STVB	1-1/4" Visual Back..........	**29.95**
STFD	Field Doubler (approx f/7)	**89.95**

ScopeTronix Dew Clip™ 12 volt Dew Heaters

DC90	ETX-90EC/RA..........	**59.95**
DC125	ETX-125 / NexStar 5	**69.95**
DC8N	Celestron NexStar 8	**89.95**
DC8	All other 8" SCT's.....	**89.95**

ScopeTronix Finder Scopes & Brackets

FS50	8 x 50 black finder	**59.95**
FS30	6 x 30 black finder	**29.95**
STFB630	6 x 30 bracket	**16.95**
STFB850	8 x 50 bracket	**24.95**

ScopeTronix LightSight™ Zero Power Red Dot Finder

LTST	LightSight™...........	**24.95**
BASE	Extra dovetail base	**3.00**

ScopeTronix Barlow Lenses

BAR2	2x..	**39.95**
BAR3	3x..	**42.95**

ScopeTronix Joysticks

ASJS	Autostar...	**49.95**
JOYN	NexStar...	**49.95**

ScopeTronix Deluxe Latitude Adjusters

LA8	For 7" & 8" LX10/50/90/200	**39.95**
LA10	For 10" LX50/200.............	**44.95**

ScopeTronix Eyepiece Bottles & Filter Cases

EPB1	EP Bottle (1)........	**2.75**
EPB4	EP Bottles (4)......	**10.00**
EPBF	Foam inserts (10)	**2.50**
STSBOX	Small 1-1/4" filter size box..........	**1.95**
STLBOX	Large reducer/corrector size box	**2.95**

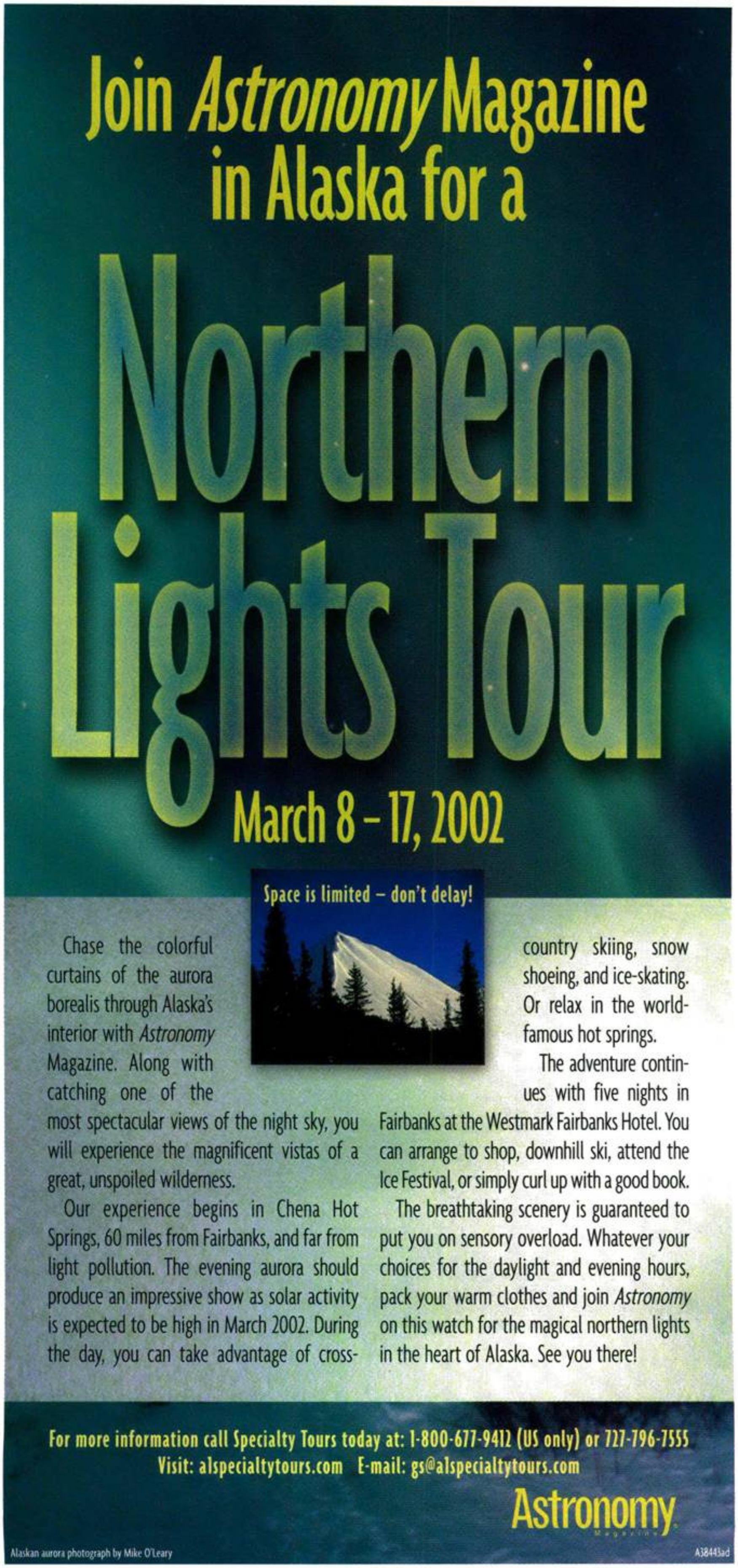
Visit our new Showroom!

ScopeTronix ETX Field Tripod Leg Clamp Set
CLMP....... **44.95**

CELESTRON
MEADE
TeleVue
Visionary

ScopeTronix Astronomy Products • 1423 SE 10th Street Unit 1A • Cape Coral, Florida 33990

24 HOUR ONLINE SHOPPING & SECURE ORDERING
WWW.SCOPETRONIX.COM



Join *Astronomy* Magazine in Alaska for a

Northern Lights Tour

March 8 – 17, 2002

Space is limited – don't delay!

Chase the colorful curtains of the aurora borealis through Alaska's interior with *Astronomy* Magazine. Along with catching one of the most spectacular views of the night sky, you will experience the magnificent vistas of a great, unspoiled wilderness.

Our experience begins in Chena Hot Springs, 60 miles from Fairbanks, and far from light pollution. The evening aurora should produce an impressive show as solar activity is expected to be high in March 2002. During the day, you can take advantage of cross-country skiing, snow shoeing, and ice-skating. Or relax in the world-famous hot springs.

The adventure continues with five nights in Fairbanks at the Westmark Fairbanks Hotel. You can arrange to shop, downhill ski, attend the Ice Festival, or simply curl up with a good book.

The breathtaking scenery is guaranteed to put you on sensory overload. Whatever your choices for the daylight and evening hours, pack your warm clothes and join *Astronomy* on this watch for the magical northern lights in the heart of Alaska. See you there!

For more information call Specialty Tours today at: 1-800-677-9412 (US only) or 727-796-7555
Visit: alspecialtytours.com E-mail: gs@alspecialtytours.com

Astronomy Magazine

Alaskan aurora photograph by Mike O'Leary

A38443ad

Mars). Although Bergreen is not a science writer, he is a master at describing people and their passions.

Sheehan and O'Meara, meanwhile, are seasoned science writers who present a scholarly work. They emphasize the history of scientific and popular "imaginations" about Mars, beginning when Mars was "a drop of curdled blood in the night sky" to earlier cultures. They also provide a very accurate background of explorations of the Red Planet. This book could be used for supplemental reading material in a university-level course.

Sheehan and O'Meara describe the early 20th-Century feuding between Percival Lowell and Eugenicos Antoniadi at length. They follow the changing theories about Mars through history and the resulting effects on fundamental scientific advances, such as the laws of planetary motion derived by Kepler.

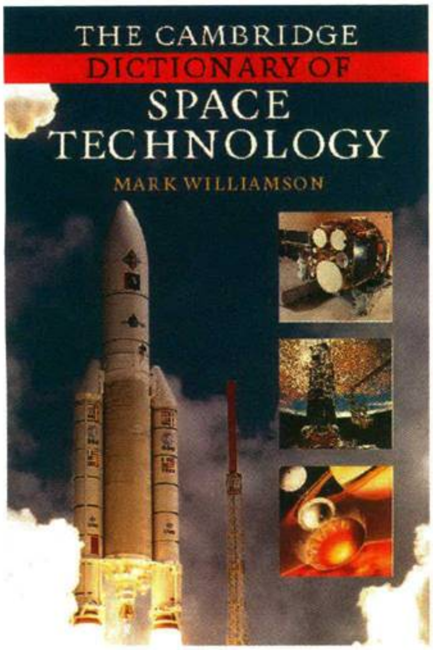
I especially liked Chapter 13, titled "Water, Water, Anywhere?" It describes the concerted effort in the late 19th and early 20th centuries to identify water on Mars — "the *sine qua non* in the quest for life." (NASA's new mantra "follow the water" isn't at all original.) The final chapters of *Mars: The Lure of the Red Planet* chronicle the discoveries leading to a new paradigm for life in extreme environments and on ancient Mars.

I found both of these books worth reading. But I would categorize *Voyage to Mars* as fitting into the fun-to-read category, while *Mars: The Lure of the Red Planet* is more deserving of a permanent place on your astronomy bookshelf. — *Alfred S. McEwen, Director, Planetary Image Research Lab, Lunar and Planetary Lab, Associate Professor, Planetary Sciences, University of Arizona–Tucson*

The Cambridge Dictionary of Space Technology

Mark Williamson, 472 pages, Cambridge University Press, New York, 2001; ISBN 0-521-66077-7; hardcover, $39.95.

I've never owned a good dictionary on the nuts and bolts of space exploration, but learned the lingo in 32 years on the job. Too bad there wasn't a tome to equal Mark Williamson's *The Cambridge Dictionary of Space Technology* when I started out.



THE CAMBRIDGE DICTIONARY OF SPACE TECHNOLOGY

MARK WILLIAMSON

Williamson emphasizes terms — not history. You can't look up every mission every flown. But if you seek to comprehend "reaction wheel," "momentum dumping," "link margin," or "pulse code modulation," — or almost anything from "airlock" to "yo-yo" (a device to decrease vehicle rotation rate, not the child's toy nor the guy who drops an eyepiece from the observatory roof) — this is the book.

There are omissions: interferometers, increasingly important in space, are missing, as are petal orbits, used in studying cislunar space. There's an error or two, as when ARPA (Advanced Research Projects Agency) the U.S. defense organization, is described as mainly doing "civil space research." This agency's name changes back and forth between ARPA and DARPA (its current name), where "D" is for "Defense."

British spellings predominate, so ammonium perchlorate is defined as a solid "oxidiser" and an astronaut, Williamson writes, conducts an EVA with a "manoeuvring" unit.

Besides technical terms, Williamson defines colloquialisms such as "glitch" and "last mile."

If you don't have a handy source of such explanations, Williamson's *Dictionary* is the book for you. I wish I'd had it earlier. — *Stephen P. Maran, Space Sciences Directorate, NASA's Goddard Space Flight Center, Greenbelt, Maryland*

Rivers CAMERA SHOP

"Call for our informative catalog"

AUTHORIZED MEADE® APD MAIL-ORDER DEALER

Meade LX200'S on display

8" LX200 $2,295 +105 P&S

New Lower Price!

Meade LX90 on display

LX90 $1,695 +95 P&S

Meade ETX-125/EC
$895.00
+30 P&S
in stock!

ETX Accessories
#126 2x Barlow $47.95
#64 Camera Adapter $34.95
ETX Tripod $199.95

Most Meade Products In Stock & On Display!

- Meade Starfinder
- Dobsonians & Equatorials
- ETX 60 + 70 AT
- DS70, DS80, DS90, DS114, DS127
- Meade Series 3000 and 4000 Eyepieces
- Most other Meade accessories in stock

Phone: (800) 245-7963 • Fax: (603) 742-5456
Hours: M-TH 8:30-6:00, Fri. 8:30-8:00, Sat. 8:30-5:30

Why Buy From Us?

NE's Largest Telescope Display

Mail-Order or In-Store. No Sales Tax!

Used Scopes — Buy, Sell or Trade-In

Knowledgeable, Helpful, Friendly Staff

TeleVue®

AUTHORIZED CELESTRON® DEALER

Nexstar Telescopes in stock

Rivers CAMERA SHOP
454 Central Ave.
Dover, NH 03820
www.riverscamera.com

ALWAYS START WITH THE BASICS.

Starry night
Telescope
LensPen

LensPen is the award-winning cleaning system for all fine optics – cameras, binoculars, and scopes. Be sure to include it on your list of basic equipment.

toll free 1-887-608-0868
www.lenspen.com

LENSPEN

LensPen is a registered trademark of Parkside Optical Inc., Vancouver, BC Canada

Astronomy
Magazine

Experience the
ECLIPSE
In the land down under!

PRETOUR TO CAIRNS/GREAT BARRIER REEF
November 23 - November 28, 2002

— ECLIPSE AUSTRALIA —
November 26 - December 6, 2002

SPECIAL EXTENSION TRIP TO NEW ZEALAND
December 6 - December 11, 2002

Explore the land and sky of beautiful Australia. You'll travel through Sydney, Melbourne and other exotic places on a full but relaxed itinerary which includes observatories, star party, planetarium, classes on the Southern Skies, the Swinburne Center for Astrophysics & Supercomputing, sightseeing and of course, the CEDUNA ECLIPSE!

So journey to the continent you've always wanted to visit for an astronomical experience of a lifetime. Pre-tour and special extension trip also available. Call today for more information!

For more information call Specialty Tours today at: 1-800-677-9412 (US only) or 727-796-7555
Visit: www.a1specialtytours.com E-mail: gs@a1specialtytours.com

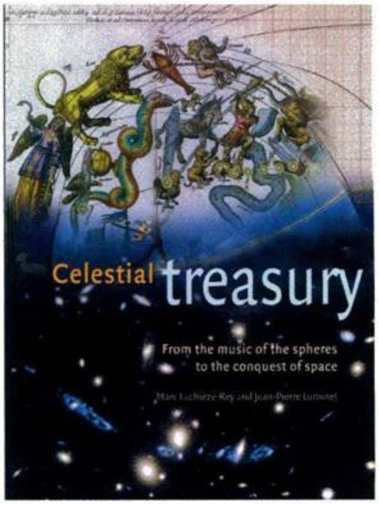
A38444ad

Celestial Treasury: From the Music of the Spheres to the Conquest of Space

Marc Lachiez-Rey and Jean-Pierre Luminet, 210 pages, Cambridge University Press, New York, 2001; ISBN 0-521-80040-4; hardcover, $59.95.

In Celestial Treasury, authors Marc Lachiez-Rey and Jean-Pierre Luminet use the juxtaposition of text and finely-detailed captions to the best possible effect in order to meld images over time.

For instance, on a typical page, readers might find a diagram of Saturn by 17th-Century astronomer Christiaan Huygens next to a recent Hubble Space Telescope photograph of that planet. The two views, spanning three hundred years, naturally invite comparison. The accompanying description ignores the obvious differences, leaping to (among other topics) Huygens's belief in the habitability of extraterrestrial worlds and his ideas about "planeticles" and "celestial Earths" — which appear positively prophetic in today's climate of extrasolar planet detection.


Celestial treasury
From the music of the spheres to the conquest of space
Marc Lachièze-Rey and Jean-Pierre Luminet

The authors, both astrophysicists at CERN, treat astronomy from the perspective of the human longing for the sky. They develop this grandiose subject both chronologically, from ancient thought to modern theory, and also thematically, from creation scenarios and the order of the cosmos to the nature of space, the measure of time, and the dream of flight.

Hundreds of characters enter the narrative, like Ulugh-Beg, the Turkish

Tamerlane's grandson, who founded a major observatory at Samarkand in 1428. There, his astronomers measured the positions of 992 stars within an accuracy of one arc-degree. Two years into his reign as king of what is now Uzbekistan, Ulugh-Beg was assassinated for "wasting his time on astronomy."

This English translation of *Celestial Treasury* from the original French *Figures du Ciel* retains a Gallic flavor. Thus the historic French Academy of Science — and its rare female arithmetician, Nicole Lepaute — figures importantly in the description of the perihelion prediction for the 1759 return of Halley's Comet. The book's discussion of late-19th and early-20th-century science fiction goes beyond Edgar Rice Burroughs to include Gustave LeRouge, whose 1909 novel, *The Prisoner of Mars,* introduced large-brained alien beings to the reading public.

Perhaps the most charming French touches are the numerous captions including lines of (translated) poetry from the likes of Guillaume Apollinaire, Paul Claudel, and Raymond Queneau.

Sharp visual thrills come via whole pages excerpted from rare books and manuscripts of exceptional beauty. One of these, Peter Apian's *Astronomy of the Caesars*, published in 1540, contained 37 hand-colored working paper "equatoria" of at least five wheels each, operated by strings and tiny pearls, as well as tables that permitted the calculation of planetary positions from 7000 B.C. to 7000 A.D. Meanwhile, Apian's Mars page, stunning in its complexity, with three of its original five strings still dangling, is reproduced in full size.

More ornate books enter discussion in a section on the evolution of celestial atlases. From about 1480 to 1600, the representation of mythological figures in the constellations was paramount.

The next two centuries saw the genre's golden age, with precision contributions from astronomers such as Tycho Brahe.

By 1801, the proliferation of astronomical knowledge had split the atlas genre into two separate branches — one catering to professional observers and the other to laymen. *Celestial Treasury*, however, will appeal to both camps. — *Dava Sobel is the author of* Longitude *and* Galileo's Daughter.

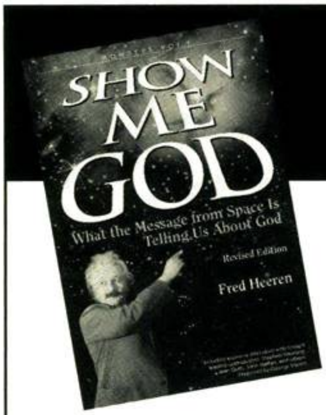
Simply out of this world

Order your subscription today!

Call 1-800-533-6644

Astronomy.com

Astronomy
Comet Fever
Astronomy



Evidence for God?

THE BOOK (NEW, REVISED EDITION):
Show Me God brings together today's top space scientists to talk about how their discoveries affect questions about ultimate origins, the likelihood of extraterrestrials, why we're here, and the nature of God.

- **Stephen Hawking** explains how God relates to his proposal from *A Brief History of Time*.
- **George Smoot** tells why he calls his NASA COBE satellite discovery "fingerprints from the Maker."
- **Alan Guth** describes the universe's "fine-tuning."
- Nobel prize-winners talk about the implications of their discovery of a "creation out of nothing."

With 100 new pages on the search for extraterrestrial life and the latest findings about the early universe, this best-selling book just got better.

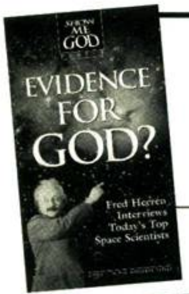
This cutting-edge book explores creation where science and religion ask the same questions and think the same thoughts.

—George Smoot, head of NASA satellite team

Brings the latest space results down to Earth—a story well told.

—John Mather, COBE satellite chief scientist

Hardcover: $22.95. Paperback: $14.95.
393 pages. 98 photos.

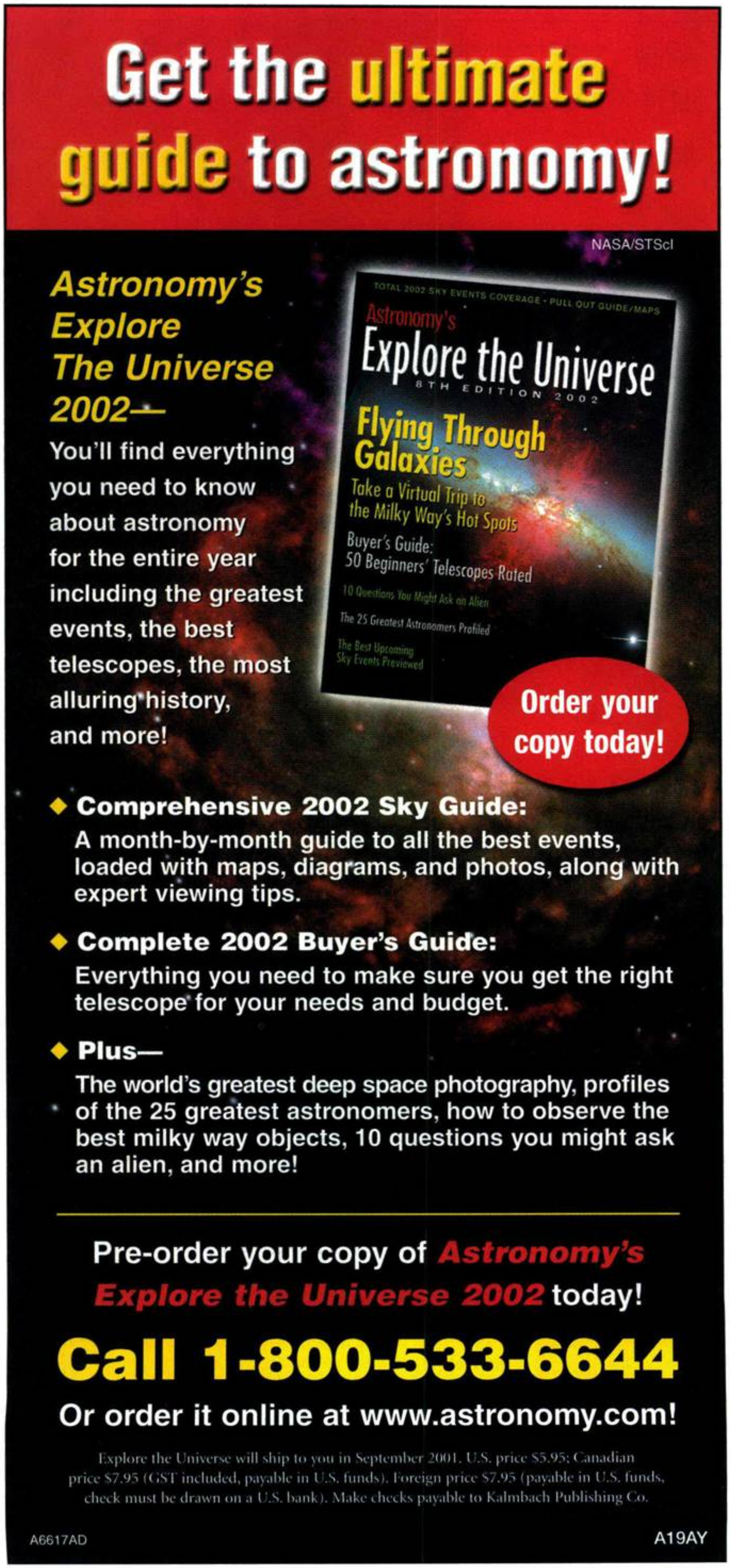


VIDEO: ***Evidence for God?***
—Fred Heeren Interviews Today's Top Space Scientists
Hear leading astronomers discuss how their discoveries affect life's big questions.
VHS. 30 minutes.
Regular: ~~$19.99~~. Intro. price: $16.88.

Cosmic Pursuit
Debate: Evidence for God?
Yes!
No!

MAGAZINE: ***Cosmic Pursuit***
For the latest on science/faith issues, order this set of four magazines (3 issues completed, 4th issue in process). Read about cosmic and biological origins, the search for extraterrestrial life, and nature's fine-tuning.
4-issue set: $24.95 in the U.S. ($29.95 outside the U.S.)
Price includes shipping.

Available at bookstores, or call today:
1-800-743-7700 Visa/MasterCard/Discover
Day Star Publications, 326 S. Wille Avenue, Wheeling, IL 60090
Make checks out to "Day Star" and add $2.20 for U.S. shipping, $6.00 for Canada, and $8.75 for other countries.
See our informative web site at: www.daystarcom.org



NASA/STScI
TOTAL 2002 SKY EVENTS COVERAGE • PULL OUT GUIDE/MAPS
Astronomy's
Explore the Universe
8TH EDITION 2002
Flying Through Galaxies
Take a Virtual Trip to the Milky Way's Hot Spots
Buyer's Guide: 50 Beginners' Telescopes Rated
10 Questions You Might Ask an Alien
The 25 Greatest Astronomers Profiled
The Best Upcoming Sky Events Previewed

Get the ultimate guide to astronomy!

Astronomy's Explore The Universe 2002—

You'll find everything you need to know about astronomy for the entire year including the greatest events, the best telescopes, the most alluring history, and more!

Order your copy today!

◆ **Comprehensive 2002 Sky Guide:**
A month-by-month guide to all the best events, loaded with maps, diagrams, and photos, along with expert viewing tips.

◆ **Complete 2002 Buyer's Guide:**
Everything you need to make sure you get the right telescope for your needs and budget.

◆ **Plus—**
The world's greatest deep space photography, profiles of the 25 greatest astronomers, how to observe the best milky way objects, 10 questions you might ask an alien, and more!

Pre-order your copy of *Astronomy's Explore the Universe 2002* today!

Call 1-800-533-6644

Or order it online at www.astronomy.com!

Explore the Universe will ship to you in September 2001. U.S. price $5.95; Canadian price $7.95 (GST included, payable in U.S. funds). Foreign price $7.95 (payable in U.S. funds, check must be drawn on a U.S. bank). Make checks payable to Kalmbach Publishing Co.

A6617AD A19AY

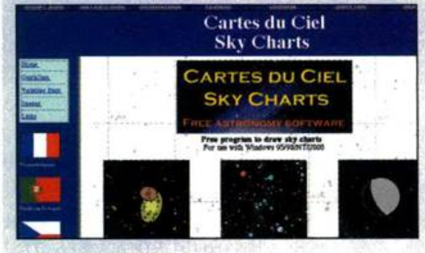
The Webweaver Picks

Views of Neptune
Neptune
HST Observes Triton and Neptune
HST Observations of Neptune

Let's continue our look at observing software, some of which is free for the downloading. While commercial planetarium programs display the sun, moon, stars, and planets for specified times, check out a few on-line alternatives before you purchase any software.

Two free, high-quality programs are Chartes Du Ciel (Sky Charts), http://www.stargazing.net/astropc/index.html) by Patrick Chevalley, and the HALLO Northern Sky (HNSKY) planetarium (http://ourworld.compuserve.com/homepages/han_kleijn/software.htm) by Han Kleij.

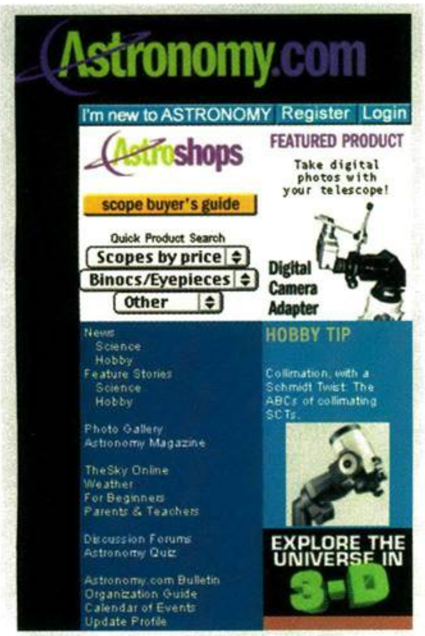
Sky Charts runs on any PC with Windows 95/98/2000 or NT and comes as a single, self-extracting 3.2 MB file. Its database includes stars up to magnitude 6.5, about 10,000 nebulae, and the sun, moon, planets, asteroids, and comets. Download additional files for planetary satellites, double and variable stars, more nebulae, and the complete TYCHO catalogue of stars to magnitude 12.


Cartes du Ciel
Sky Charts
Cartes du Ciel
Sky Charts
Free Astronomy Software
Free program to draw sky charts
For use with Windows 95/98/NT/2000

Similarly, HNSKY runs on Windows and comes as a 400 KB WinZip file. For solar system bodies, stars and deep-sky objects, additional files must be downloaded into the original folder. Both programs work well, but Sky Charts has more features and is a little easier to use.

In comparing the data to a commercial program, Sky Charts also displays slightly more accuracy when users calculate a planet's position, size, and magnitude.

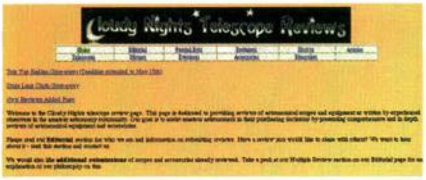
If you want to buy binoculars or a telescope, or if you're looking to upgrade, there are websites that can help you make an informed decision. The first place to visit is *Astronomy* magazine's website, Astronomy.com's "Buyer's Guide


Astronomy.com
I'm new to ASTRONOMY
Register
Login
Astroshops
FEATURED PRODUCT
Take digital photos with your telescope!
scope buyer's guide
Quick Product Search
Scopes by price
Binocs/Eyepieces
Other
Digital Camera Adapter
News
Science
Hobby
Feature Stories
Science
Hobby
Photo Gallery
Astronomy Magazine
TheSky Online
Weather
For Beginners
Parents & Teachers
Discussion Forums
Astronomy Quiz
Astronomy.com Bulletin
Organization Guide
Calendar of Events
Update Profile
HOBBY TIP
Collimation, with a Schmidt Twist: The ABCs of collimating SCTs.
EXPLORE THE UNIVERSE IN 3-D

for Beginners," which takes you through a series of questions to help choose the equipment that's best for you. Go to http://www.astronomy.com.

Another place to visit for equipment information is http://www.excelsis.com/vote/astro/index.html. Here, users rate each item — but be aware that manufacturers and retailers sometimes cast bogus votes to make their products rate higher than those of direct competitors.

For an unbiased opinion, try the reviews at Cloudy Nights Telescope Reviews: http://www.cloudynights.com. Cloudy Nights taps users without financial conflicts of interest to review each piece of equipment. A beginner's section recommends scopes for those new to the hobby.


Cloudy Nights Telescope Reviews

PRODUCT INFO

Suppliers should send announcements and color photographs to Star Stuff, P.O. Box 1612, Waukesha, WI 53187, or e-mail starstuff@astronomy.com. *Astronomy* assumes no responsibility for the product information supplied by manufacturers. Prices are retail and subject to change without notice. Check *Astronomy*'s website for further product updates — http://www.astronomy.com

THE RIGHT TELESCOPE FOR THE BEST PRICE.

- We carry the *full* line of Celestron products.
- Friendly, knowledgeable staff.
- Best prices, best selection.

NEXSTAR 11 GPS ***$2995***
NEXSTAR 8 with tripod
NEXSTAR 4
C150 HD with tripod
NEXSTAR 5 with tripod

THE TELESCOPE STORE
CELESTRON NexStar
CELESTRON *Showcase Dealer*

Visit our store at 12 Main Street, Keene, NH or check out our web site for up to the minute pricing.

www.telescopes-earth.com
1-800-550-7192

DISCOVERY TELESCOPES
2001 CELEBRATES OUR 10TH ANNIVERSARY

FREE!!! DISCOVERY LASER COLLIMATOR with Every DHQ, Truss Design and Premium DHQ Telescope

TRUSS DESIGNS
PREMIUM DHQ
DHQ
EQ

Ask for a FREE Discovery Catalog showing our complete line of Telescopes, Optics and Accessories
Order online or toll free:
(877) 523-4400
visit our website at:
www.discovery-telescopes.com

Astronomy's

Marketplace

Welcome to the MARKETPLACE section in ASTRONOMY Magazine. These pages are specifically designed to be an affordable and highly effective way for you to market astronomy-related products or services. Call Michael Ellis at 888-558-1544, ext. 636 to place your advertising message here.

www.novaspace.com
SPACE ART

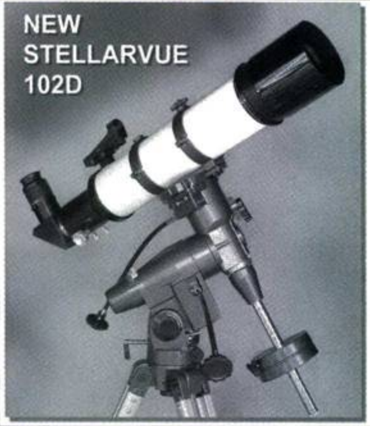
NISUR systems **Limited SALE!!**

Capella II altaz.-$99.00
Tripod Converter-$19.95
Mounts - P3 Tri-piers
Accessories
order-info - 973 790 5555
http://nisursystems.com

Single? (just as soon not be?)

Expand your social universe (and maybe meet your true love) though: ***Science Connection***

800-667-5179
www.sciconnect.com



STELLARVUE

TOP-RATED REFRACTORS

SECURE ONLINE ORDERING
WWW.STELLARVUE.COM

WRITE FOR FREE CATALOG
PO BOX 7515
AUBURN, CALIFORNIA 95604-7515

bigbinoculars.com

Astronomical binoculars and accessories at the guaranteed lowest prices. (937) 675-6792
www.bigbinoculars.com

OBERWERK FUJINON

THE AMAZING DOB DRIVER II

Dual axis microstep quartz drive fits all Dobsonians, or user-built equatorials. Powerful computerized tracking, panning, and guiding in the palm of your hand! Super portable, super simple, AC/DC/CAR/BAT 12V. Instant setup–NO ALIGNMENT! Multi-function display. Calibration supertunes your scope to maximum performance. Options for PC link/CCD link.

New Roboscope PC Software
Go to 13,000 + objects + any chart point

Control only - $349 ATM System - $510
Complete system w/ready-to-install drives - $599
Free catalog - satisfaction guaranteed!

TECH 2000
69 S. Ridge St. Monroeville, OH 44847
Ph. 419-465-2997 • Fax 419-465-2484
www.accnorwalk.com/~tddi/tech2000

ASTRO-PHYSICS

High-quality instruments for discriminating observers and astrophotographers

Refractors- 105,130,155 mm dia.
Go-To German Equatorials
Visual and Photographic
Accessories

155 Starfire EDFS with 2.7" Focuser,
900GTO German Equatorial
Accessories

11250 Forest Hills Rd.
Rockford, IL 61115 USA
Ph: 815-282-1513, Fax: 815-282-9847
www.astro-physics.com

MOUNTING ASSISTANT™

Don't drop your scope!

Greatly simplifies the mounting of Meade LX200 7" through 12" scopes. This compact low cost design permits easy access to eyepiece when viewing at zenith. And permits convenient storage in a tight space such as a closet without disassembly. Black anodized ¼" thick precision aluminum plate with vinyl covered steel mounting guide posts **$77.85**

Peterson Engineering Corp., Sky Division
405 New Meadow Rd., Barrington RI 02806
US/Canada toll free (888) 712-9332 (401) 245-6679
Visit www.peterson-web.com for more Sky products

TELESCOPE KITS, LENSES, ACHROMATS
MIRRORS, MIRROR BLANKS,
ALUMINUM COATINGS & ACCESSORIES
BUY DIRECT ★ DO IT YOURSELF

Stock & Custom mirrors and molded mirror blanks, diagonals, parts made from Pyrex, optical glasses, fused silica, quartz and other low expansion ceramic materials. Telescope accessories, do-it-yourself books.

Write, call, fax or e-mail for catalog

NEWPORT GLASS WORKS, LTD.
P.O. Box 127
Stanton, CA 90680
PH: (714) 484-8100
FAX: (714) 484-8181
E-mail: astronomy@newportglass.com
Web: http://www.newportglass.com

new. mexico skies

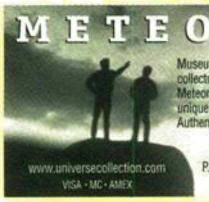
GUEST OBSERVATORY

☆ *Spectacular Skies*
DARK Steady Mag 7+ skies
Great Seeing - 7300' elevation
Near: Apache Point & Sunspot

☆ *Great Equipment*
16"/12" Meade LX 200
14" Celestron / Paramount
7" Astro Physics APO
30"/25"/15" BIG Dobs
Full line SBIG CCD cameras

☆ *Modern Accommodations*
Full size kitchens/3-2-1 bedrooms

Mike and Lynn Rice, Astronomers
www.nmskies.com
info@nmskies.com
Phone: 505-687-2429/Fax: 505-687-3710
P. O. Box 559, Cloudcroft NM 88317


METEORITES

Museum-Quality collectors' specimens.
Meteorite jewelry, books, unique gift items.
Authenticity guaranteed.

Color Catalog
$3 USA, Canada and Mexico
$6 Foreign
Refundable with order.

The Universe Collection
P.O. Box 3726-A, New Haven, CT 06525-0726
203 393-3395 fax 203 393-2457

www.universecollection.com
VISA • MC • AMEX

....KITES!
Windsocks, Flags and Spinners
Traditional, Stunt and Power Kites
Free 80 page Catalog, or shop online at:
www.intothewind.com
1408-A Pearl St., Boulder, CO 80302 • (800) 541-0314

8" f/6 • 10" f/5
12.5" f/5
14.5" f/4.3

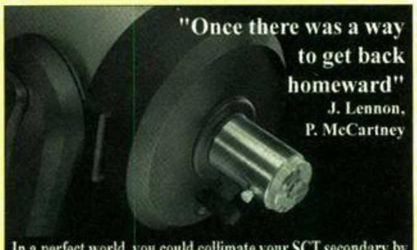
Have You Evolved Yet?
Mag 1 Instruments Portaball
Quick Set-up • Rotatable Tube
Optics by Zambuto Optics
SEE It Spin Online!
mag1instruments.com
262-785-0926

ECLIPSE CRUISE '02
aboard the 128 passenger CLIPPER ODYSSEY
November 28 - December 8, 2002
Includes tours of
Sydney - Adelaide - Melbourne
eclipse 700 miles W. of Adelaide
Technical Advisor - Steve Last
exclusively chartered by
TRAVEL WIZARD
7788 University Ave., La Mesa, CA 91941
1-800-708-7677
(619) 464-1946 • FAX: 462-5278
glow in the dark eclipse T-shirts & patches
www.travelwizardtravel.com

Wired • Wireless • Solar
Weather Instruments
Weather Warehouse
At Wholesale Prices
www.weatherwarehouse.com

SURPLUS SHED℠
SURPLUS OPTICS AND ELECTRONICS
FREE CURRENT LIST
Phone/fax/faxback TOLL FREE:
1-877-7SURPLUS • 610-926-9226
E-Mail: SURPLUSHED@aol.com
WWW: http://www.SurplusShed.com
407 U.S. Route 222, Blandon, PA 19510

EUROPE'S PREMIER WEBSITE
http://www.scsastro.co.uk
SCS ASTRO


"Once there was a way to get back homeward"
J. Lennon, P. McCartney

In a perfect world, you could collimate your SCT secondary by squaring it with the optical axis. In the real universe, the SCT Re-Collimator and one good star test will precisely mark, and get you back "home" to your best secondary adjustment. Anytime.

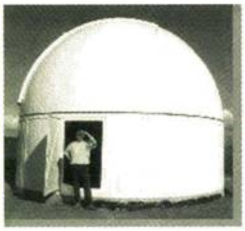
SCT Adapter Tubes
$35 & $55

SCT (2" Single Beam) Re-Collimator $135

And...the finest Green Laser SkyPointers™, SkyFinders™, and Collimators in **this** Solar System

Howie Glatter 3850 Sedgwick Ave. Bronx, N.Y. 10463
Tel/Fax (718) 796 3203
www.skypointer.net www.collimator.com
e-mail: howieglatter@mindspring.com

'SIRIUS' direct from **Australia**


Sizes
7'6" or 11'6" or 22'0" dia.

Solid Fibreglass, whisper quiet. Mechanised dome rotation and hatch openings available.
Visit www.siriusobservatories.com
e-mail info@siriusobservatories.com

Star Hill Inn
an astronomy retreat in the rockies

Experience a unique dark sky vacation. Stay in charming private cottages on hundreds of acres of peaceful pines. 7200' elevation. Star tours, telescopes for rent, or use your own at our observatory. Astronomy, Birding and Art Workshops. Easy access to Santa Fe, Taos, Pecos Wilderness, Wildlife Refuges & Ski Resorts.
Open all year. For info:
Star Hill Inn
Sapello, New Mexico, 87745
505-425-5605
www.starhillinn.com

ASTROLA™ Mirrors
Build the telescope of your dreams.

Astrola 8-inch f/6 mirror set	*$ 950**
Astrola 10-inch f/6 mirror set	*$ 1195**
Astrola 12.5-inch f/6 mirror set	*$ 1495**

Hardin Optical Company
Take a tour of our Mirror Lab at: www.astrola-optics.com
* F.O.B. Bandon, OR

Astronomy's

Marketplace

T&T BINOCULAR MOUNTS & BEYOND LLC

You Can't Go Wrong with T&T ARTi Mount!
Astronomy rated it BEST BUY
of 2000! $205 (plus s+h)

18 Strong St. Extension
East Haven, CT 06512
(203) 469-2845 or (203) 272-1915
www.benjaminsweb.com/TandT
E-mail: TELloyd@aol.com

Starsplitter Telescopes
Quality Focused on the Customer!

We offer the largest selection of Newtonian telescopes on the market today!

Please send $2.00 for a catalog. Online catalog at www.starsplitter.com

Starsplitter II
15"- 40"
Compacts
8"-15"

Starsplitter Tube
6"-10"
APO - Eater
6" f/10 & 8" f/8

Starsplitter Telescopes
3228 Rikkard Drive
Thousand Oaks, CA 91362
805-492-0489 Phone & Fax
www.starsplitter.com

AUSTRALIAN OUTBACK ECLIPSE
DECEMBER 2002

- Spectacular sunset eclipse
- Southern skygazing parties

Call for FREE Brochures 800.830.1998

TravelQuest INTERNATIONAL
305 Double D Dr., Prescott, AZ 86303 USA
Visit us at: www.tq-international.com

Buy a Star ★ Name a Star

On the exclusive
MSAS Star Atlas
Soon to be placed in the newly-opened
MSAS Astronomy Village
Receive a certificate of record and more.

Free brochure.
Starting at only $25.00!
VISA/MC accepted

(909) 336-1699
Mtn. Skies Astronomical Society
Box 1169 - LkArwhd, CA. 92352
www.mountain-skies.org

South Australia Total Solar Eclipse Cruises

Our 6th eclipse Dec. 4, 2002

Two unique 10 day sailing adventures on Australia's historic tall ships from Adelaide to Ceduna.

Tropical Sails Corp
800-595-1003
915-595-1003
www.tropicalsails.com

- Rotating dome
- Stationary base
- 25-minute setup
- Several sizes

Sky Tent
www.skytent.com
toll free: 1-877-SkyTent

Observatories for portable or permanent use

UNIVERSITY OPTICS, INC.
P.O. BOX 1205
ANN ARBOR, MICHIGAN 48106-1205

For over 37 years your source for everything astronomical including —
- Cookbook CCD Camera kits
- Eyepieces
- Telescope making parts

New Online Catalog
www.universityoptics.com

Call for FREE CATALOG
734-665-3575

Astrotec
Low Prices Long Island, NY

CELESTRON•MEADE
Lumicon • JMI • Kendrick • TeleVue • Orion
http://www.astrotecs.com
4132 Sunrise Hwy.
Oakdale, NY 11769
Tel: 631-563-9009
Fax: 631-563-9018

NEW AUTHORS
PUBLISH YOUR WORK
ALL SUBJECTS CONSIDERED
WRITE, OR SEND YOUR MANUSCRIPT TO:
MINERVA PUBLISHING CO.
1001 BRICKELL BAY DR., # 2310, MIAMI, FL 33131

ECLIPSE SHADES™
Safe Solar Viewers
Custom Imprinting Available!

ECLIPSE SHADES
SAFE FOR DIRECT SOLAR VIEWING

Eclipse Shades™ provide the ultimate in protection from harmful Solar Radiation. Lenses made of Optical Grade, Neutral Density 5 Mylar, filter out 100% of Ultra-Violet, 100% of Infra-Red, and 99.999% of Visible Light.

Quality Paper Eyewear & Specialty Optics
Rainbow Symphony, Inc.
6860 Canby Ave. #120, Reseda, CA 91335
1-800-821-5122 FAX (818) 708-8470
E-Mail: eclipse@rainbowsymphony.com
www.rainbowsymphony.com/soleclipse.html

STELLAR ENDEAVORS, INC.
6701 Seybold Rd, Suite 209
Madison, Wisconsin 53719
(608) 271-6666

The AstroCam
The most affordable and easy to use color digital camera for amateur telescopes.

$194
Software Included!

Windows 95/USB port required

Back to School Special
FREE Shipping & Handling!

Guides to the Night Sky
2 Digitally Mastered Audio CDs

$29.95
The easiest way to learn the nighttime sky.
The perfect supplemental text for introductory astronomy courses!
"...truly fun..." - David H. Levy

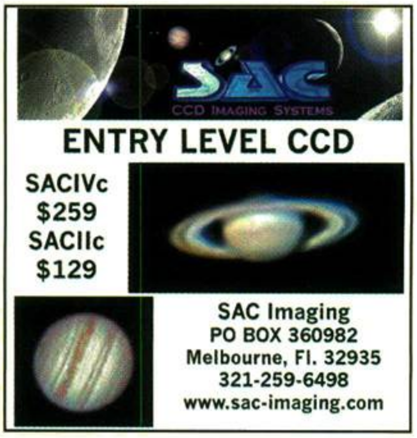
www.stellarendeavors.com

Astroshops.com
Your one-stop shop for telescopes & astronomy-related products

STAR TEK
FINE ASTRONOMY PRODUCTS
See our '3-in-1' tray and other new products at
www.startekind.com
Toll Free: 888-416-9480
Pat. Pend.

SCOPESAVER
BB200 OBSERVING TABLE
PRICE $99
The **BB200** is the heart of the ***Scopesaver*** observation station. It fits all ***Meade*** Telescopes that use a standard tripod, including LX200 (7-12"), LX50 (7-10"), 2045D, 2080/2100 (8-10"), all Meade refractors, and some **Celestrons.** The 12x20x1/4" aluminum table is black anodized. Additional accessories available. Amex-M/C-Visa. **Beigle/Bryant Engineering**, P.O. Box 5247 • Pine Mountain Club, CA 93222
800 330-8339 ■ **www.scopesaver.com**
Phone: (661) 242-5804 Fax: (661) 242-1502

It's From Out of This World!
NEW ENGLAND METEORITICAL SERVICES
Free Catalogue and Mailings
Box 440-A
Mendon, MA 01756
USA
Tel: 508-478-4020
Fax: 508-478-5104
www.TouchAnotherWorld.com


SAC CCD IMAGING SYSTEMS
ENTRY LEVEL CCD
SACIVc $259
SACIIc $129
SAC Imaging
PO BOX 360982
Melbourne, Fl. 32935
321-259-6498
www.sac-imaging.com

AD INDEX

We believe that our readers are as important as our advertisers; therefore, we try to handle all reader's complaints promptly and carefully. If, within 30 days you do not receive your merchandise or an adequate reply from an advertiser, please write to us. In your letter describe exactly what you ordered and the amount of money you sent. We will forward your complaint to the advertiser for action. If no action is obtained, we will refuse to accept further advertising from him. Address complaints to: ASTRONOMY Magazine, 21027 Crossroads Circle, P. O. Box 1612, Waukesha, WI 53187.

Adorama .16, 17
Astro-Physics .96
Astronomics .72,73
Astronomy Magazine .101
Astronomy.com .79, 102
Astronomyquest.com .31
Astrotec .98
Atomic Time .16
Beigle/Bryant Engineering .99
Bethany Sciences .97
Cambridge University Press .87
Camcor, Inc. .85
Celestron International .18, 19, 21
Day Star .93
Discovery Telescopes, Inc .95
Eclipse 2002 Tour to Australia .92
Eclipse Edge Expeditions .23
Edmund Scientific .23
Enchanted Skies Star Party .23
Explore the Universe 2002 .94
Focus Camera .54, 55
Fujinon .16
Glatter, Howard .97
Hardin Optical Co. .31, 97
Into the Wind/The Kite Source .97
JMB, Inc .88
Jim's Mobile Industries .45
Kendrick Astro Instruments .31
Le Sueur Manufacturing Co. .31
Let's Talk Stars .31
Lumicon .25
Mag One Instruments .97
Marketplace Pages .96, 97, 98, 99
Meade Dealer Pages .12, 13
Meade Instruments Corp. 2, 3, 7, 8, 9, 10, 11, 114
Minerva Press .98
Mountain Skies Astronomical Society .98
New England Meteoritical .99
New Mexico Skies .96
Newport Glass Works .96
Nisur Systems .96
Northern Lights Tour 2002 .90
Novaspace .96
Oceanside Photo & Telescope 15
Orion Telescopes & Binoculars .66, 67, 113
Parkside Optical Inc .91
Peterson Engineering .96
Pocono West Optics .83
Rainbow Symphony .98
Retail & Travel Directory .100, 101
Rivers Camera Shop .91
SAC Imaging Systems .99
SCS Astro .97
Science Connection, Inc. .96
Scope City .85
Scope Tronix .89
Shutan Camera & Video .27
Sirius Observatories .97
Skytent International .98
Star Hill Inn .97
Star Tek Industries .99
StarSafaris.com .88
Starsplitter Telescopes .98
Stellar Endeavors .98
Stellarvue .96
Surplus Shed .97
T &T Binocular Mounts & Beyond LLC .98
TRW Space & Electronics Group .29
Tech 2000 .96
Technical Innovations .88
The Telescope Store .95
Travel Quest .98
Travel Wizard .97
Tropical Sails .98
University Optics, Inc. .98
The Weather Warehouse .97
Woodland Hills Photo Images .23
www.bigbinoculars.com .96

Astronomy's

Retail & Travel Directory

The Directory is designed to be a quick and easy way to locate astronomy-related retail stores, activities, planetariums and observatories. To advertise call toll free 1-888-558-1544 ext. 487

RESORTS

TEXAS - Alpine 79830

TERLINGUA RANCH RESORT

Some of the darkest skies in the United States!
Remote, Quiet & Beautiful!
Adjoins Big Bend National Park.
Two hours from McDonald Observatory.
Cabins, RV Sites & Camping. For information:
www.terlinguaranch.com

HC 65 Box 220 (915) 371-2416

RETAIL SHOPS

FLORIDA - Sarasota 34236

WOLF CAMERA

Telescopes
Meade
Celestron
Tele Vue®

CCD Equipment
Meade Pictor
Optec Max.
Accessories

WOLF CAMERA

The Largest Telescope Dealer in the Southeast! New & used telescopes, CCD equipment & accessories, plus a huge selection of eyepieces and binoculars! Call Chuck Pisa our staff Astronomer with 20 years experience today!

www.wolfcamera.com Fax: (941) 952-0278
1055 S. Tamiami Trail (941) 957-4686

GEORGIA - Atlanta 30306

CAMERA BUG

TELESCOPES • BINOCULARS • ACCESSORIES
EYEPIECES • SPOTTING SCOPES • MAPS • BOOKS

Canon • Celestron • Meade • Minolta • Olympus
Orion • Pentax • TeleVue® • Kendrick • Rigel

WE SHIP ALMOST ANYWHERE!
www.camerabug.com
Fax: (404) 873-3925
Orders Only: (800) 545-8509

1799 Briarcliff Rd. (404) 873-4513

MONTANA - Darby 59829

ITE TELESCOPES

Maksutov Telescopes by INTES & INTES MICRO (Sales/Service) Custom Maksutov & Off-Axis Parobolic Relectors in Light - Weight Graphite Tubes GOTO EQ Mounts * GR-2 Alt-Az Mounts * Starlight Xpress CCD Cameras BORG Refractors * KIEV Medium Format Cameras* Telescope Repairs

cescoweb@aol.com www.burnettweb.com/ite
3555 Singing Pines Road (406) 821-1980

RETAIL SHOPS

NEW YORK - Amityville 11701

BERGER BROS.
CAMERA•VIDEO•DIGITAL

In Business Over 50 Years.
"We Don't Just Sell It… We Use It!"

TELESCOPES•BINOCULARS•CAMERAS
We Carry: Meade • Celestron • Swarovski
Leica • Zeiss • Steiner • Fujinon • Pentax

Bausch & Lomb • Bushnell • Nikon • Canon
Catalog Available • We Ship Nationwide
http://www.berger-bros.com

Phone: (631) 264-4160 Fax: (631) 264-1007
209 Broadway (Route 110) (800) 262-4160

Subscribe to *Astronomy*! 1-800-533-664

TEXAS - Dallas 75252

THE OBSERVATORY, INC.

The Most Complete Telescope Store in Texas

TELESCOPES * MICROSCOPES * BINOCULARS

In the field set-up & instruction with every Astronomical Telescope purchase
Astronomical Telescopes * Spotting Scopes
Binoculars & Giant Binoculars * Sky Charts
Atlases, Books * Computer Controlled Telescopes
Astronomy Software

Celestron, Meade, Orion, Tele Vue®, Geochron, Canon, Swift, Spherical Concepts, Fujinon Home-Dome by Technical Innovations

www.TheObservatoryInc.com

19009 Preston Rd, Suite 114 (972) 248–1450

TEXAS - San Antonio 78250

Analytical Scientific
"The Source For All Your Astronomy Needs"™

Visit our showroom and see the largest selection of telescopes in Texas. Meade, Celestron, Tele Vue®. Telescopes, binoculars, microscopes, spotting scopes, accessories, books, charts, posters. Science, nature and educational items.

E-Mail: asltd@analyticalsci.com

http://www.analyticalsci.com Fax: (210) 520-3344
11049 Bandera Rd. (800) 701–STAR (7827)

RETAIL SHOPS

CANADA - Ontario - Toronto M6A 2T2

Shop on-line at www.khanscope.com

MEADE APD PRODUCTS

Our 15th Year!

NEW!!
MEADE 8" LX90

Celestron • Meade • Tele Vue® • Skywatcher
Binoculars • Spotting Scopes • Books,
Software • Low Prices
All Major Brands on Display
We Welcome trade-ins, Buy Used. Repairs & Service.
Toll Free (800) 580-7160

KHAN SCOPE CENTRE Ph. (416) 783-4140
3243 Dufferin St. Fax (416) 783-7697

CANADA - Toronto - Ontario M6A 3A4

Shop online at www.telescopes.ca

EfstonScience
Serving Observing Since 1970
The Science & Astronomy SuperStore
Canada's largest selection of telescopes
MEADE
CELESTRON
TELEVUE
and more!
ONLY AT EFSTONSCIENCE!
"…sets a new standard for an instrument in this price range."
—Terence Dickinson
Call for you FREE catalog, or shop online at www.telescopes.ca

THE LARGEST TELESCOPE DEALER IN CANADA!
All major brands available and in stock. New and used equipment on display and online - trade-ins welcome.
Call our experts & visit our website for star charts & more.

info@e-sci.com Phone: 888-777-5255
3350 Dufferin St. Fax: 888-681-1079

TRAVEL

WASHINGTON - Seattle 98112

ARCTIC ODYSSEYS™

With a renowned astronomer, witness the
AURORA BOREALIS at the Solar Maximum or the
2000 HIGH ARCTIC SOLAR ECLIPSE.
Also, North Pole, Baffin and Ellesmere Islands,
Siberia, China, Polar Bear, wildlife,
dog sled, cultural tours and more!
www.ArcticOdysseys.com
Fax: (206) 726-8488

2000 McGilvra Blvd E, Ste A (800) 574–30214

You can affordably attract customers straight to your web site with an ad in the Web Site Directory.

NEW! WEB SITE DIRECTORY IN Astronomy®

Learn more about this targeted advertising opportunity. Call Rachel Larson at 1-888-558-1544 ext. 487

Astronomy's
Classifieds

This section is open to anyone who wants to buy astronomy-related merchandise. *RATES:* $1.56 per word. Minimum charge is $14.00 per issue. Prepayment required. Frequency discounts available. All copy is set in standard typography. *CLOSING DATE:* 1st of the month, three months before the cover date (i.e., March 1st for the June issue). Send your ads to *Astronomy*, Classifieds, PO Box 1612, Waukesha, WI 53187-1612. 1-888-558-1544 ext. 815. Major credit cards accepted.

ACCESSORIES FOR SALE

Binoviewer complete ready to use. EzDSC for palm size PC. Equatorial and Altazimuth platform kits. TL Systems, 2184 Primrose Avenue, Vista, CA 92083. (760) 599–4219. tlsystem@ix.netcom.com or http://www.netcom.com/~tlsystem/

Eric's Window to the Universe: Telescopes, Binoculars, Spotters, Night Vision, Range finders, Software, Posters and Accessories. We Carry: Celestron, Orion, Meade, Bushnell and Night Owl Optics Products. Lexington, KY (859) 335-8836 or Visit www.ericstelescopes.com or Info@ericstelescopes.com

PUBLICATIONS AND WEB SITES

COSMIC PERSPECTIVE, Revolutionary cosmology treatise, reveals big bang fallacy: www.webservr.com/science

ANNOUNCEMENTS/OPPORTUNITIES

Midwest Birding Symposium 2001 is winging its way to Wisconsin! Mark your calendars now for the 2001 Midwest Birding Symposium (MBS). Thursday, August 30 through Sunday, September 2, 2001. Hosted by BIRDER'S WORLD Magazine, EAGLE OPTICS, & the WISCONSIN SOCIETY FOR ORNITHOLOGY. The symposium will offer a varied menu of speakers and field trips of the state, Green Bay is surrounded by wetlands that vary from Lake Michigan shoreline to cattail marsh and sedge meadow. The area lies along major pathways for fall migrants. Speakers include John Acorn, George Archibald, Kenn Kaufman, Arthur Morris, Peter Stangel and more. The symposium will be held at the Regency Suites Hotel and KI Conference Center in downtown Green Bay. For accommodations, call (800) 236-3330. Sponsors include Swift Instruments, Leica Sports Optics, Swarovski Optics, Kaytee Products, Wild Birds Unlimited, National Fish & Wildlife Foundation, WI Dept. of Natural Resources, US Fish & Wildlife Service, the Green Bay Area Visitor & Convention Bureau, Friends of Bay Beach Wildlife Sanctuary, and Mosquito Hill Nature Center. Additional information can be found on the BIRDER'S WORLD Web site: www.birdersworld.com. Jenny Birkel at (800) 558-1544 ext. 245; or e-mail at jbirkel@kalmbach.com.

SOFTWARE FOR SALE

Get Star Mapping and other astronomy software for your Palm OS compatible handheld! For more information visit http://www.start-pilot.com Or send E-mail to sp@star-pilot.com

TELESCOPES FOR SALE

For Sale Takahashi FS-102, 4 inch fluorite refractor, O.T.A Excellent condition, includes 6x30 finderscope, 1.25 inch Star diagonal. $1800 (218) 262-5114

Nexstar 8 (Like New) with dewshield, solar filter, tripod, and case. $1,950.00+ S&H Contact Anthony @ (859) 273-3554 or E- mail tonyb@excelonline.com

Astronomy.com
UPDATED DAILY!

It's like a dream come true... FREE Advertising!

Reach your potential customers on the World Wide Web, 24 hours a day, 365 days a year!

*Now featuring a free listing on the internet when you purchase a classified word ad in **Astronomy** Magazine!*

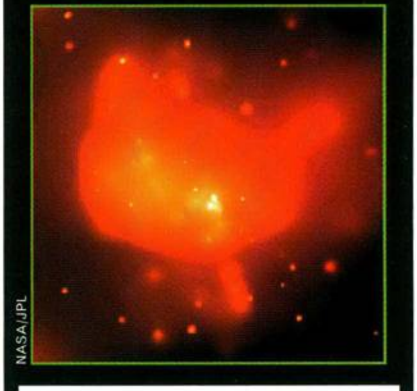
Contact a Classified Representative at 1-888-558-1544, ext. 487

KALMBACH PUBLISHING CO.

Kalmbach Publishing Co. 21027 Crossroads Circle
P.O. Box 1612, Waukesha, WI 53187-1612

http://www.astronomy.com

NEXT month in Astronomy


NASA/JPL

HEART OF DARKNESS

A massive black hole at the Milky Way's center dominates everything in its neighborhood.

RAISING THE LIBERTY BELL 7

Nearly 40 years after Gus Grissom's spacecraft ended up on the ocean floor, explorers found and recovered it.

AFRICA'S GRAND ECLIPSE

More than three minutes of fiery prominences and a wispy corona awed African eclipse chasers.

AUTUMN'S TINY TRIO

Sagitta, Delphinus, and Vulpecula may be small, but they pack plenty of deep-sky wonders.

Subscribe Today!

800-533-6644

Order online at

Astronomy.com

EAGLE OPTICS

AstronomyQuest.com

Astronomy Magazine

Woodland Hills Camera & Telescopes

astroGRAPHICS PUBLISHING

yes

RENAISSANCE OPTICS

KONUS Optical & Astronomy Systems

Science ART Co. Classical Scientific Instruments

DISCOVERY TELESCOPES

OPTICS PLANET.COM performance·precision·price·value

EZTelescope.com

Heritage House PUBLISHING COMPANY LTD.

OCEANSIDE PHOTO & TELESCOPE

Astronomy Optics

STAR SAFARIS

3vine telescopes FREE Shipping All The Time!

Hardin Optical The Astronomy Company

ASTRONOMICAL SOCIETY OF THE PACIFIC

NatureWatch

STELLAR ENDEAVORS

AC_37939ad2

Astroshops.com

Grand Re-opening Sale

Visit **Astroshops.com** and find everything you need:

Telescopes
Binoculars
Eyepieces
Software
Books
Accessories
and more

ROCK STARS

Cactus Flowers Point to the Stars

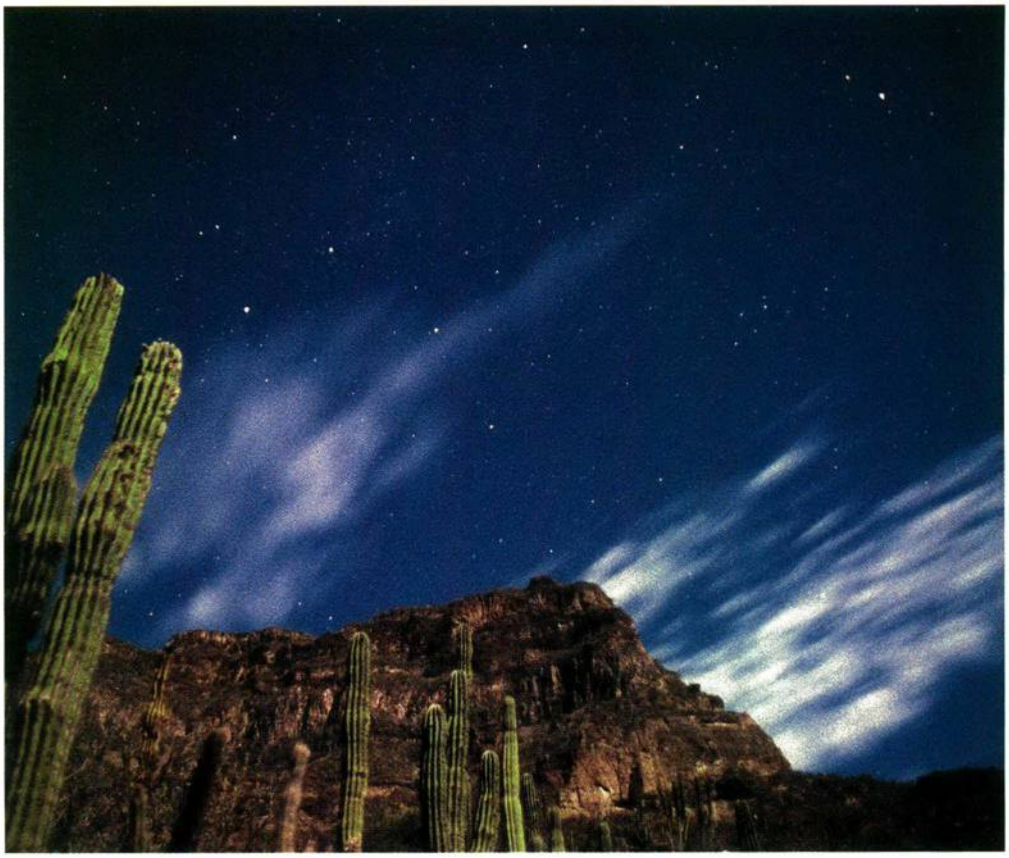
▶In April 2000, I journeyed to a remote mountain range 500 miles down Baja California's skinny peninsula from my hometown of San Diego, California, to view several of the finer pictograph sites found in what's known as the Great Mural Rock Region of Mexico. Thanks to the remote location and a waning gibbous moon, it was also a great place to practice my specialty within astronomy: landscape astrophotography.

UNESCO has designated the area a "World Class Rock Art Site," and estimates that the artwork dates from 3000 B.C. to A.D. 1650.

Frozen in stone for centuries, these larger-than-life cave paintings in the central-peninsula mountain ranges typically depict humans with arms reaching upward, running or leaping animals, birds in flight, and dorsal views of fish. The murals include an apparent rendering of the supernova birth of the Crab Nebula in A.D. 1054.

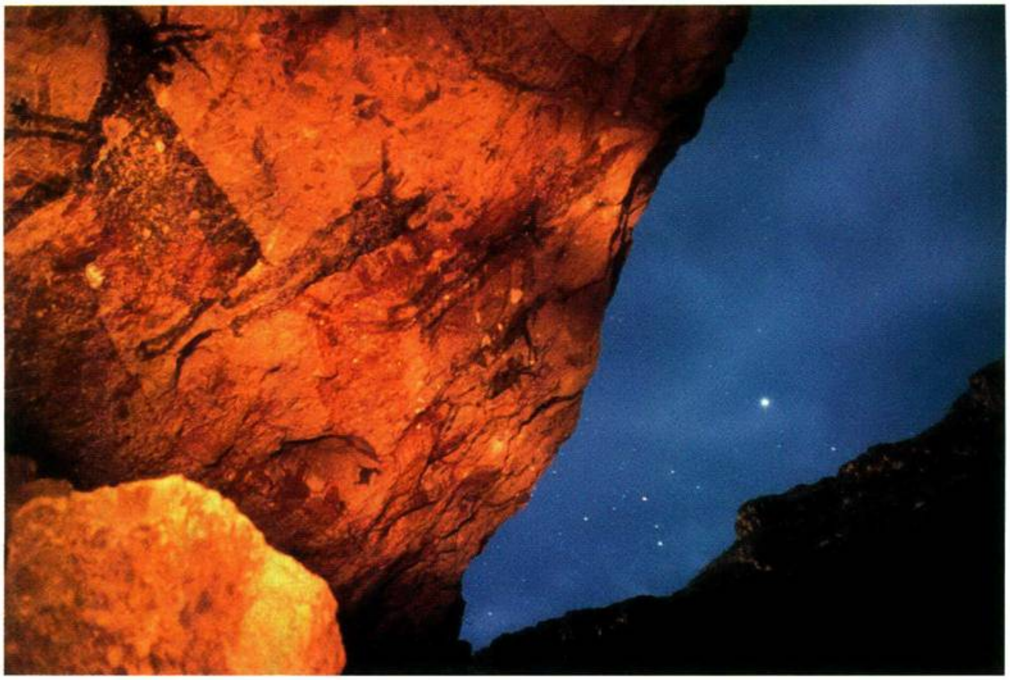
Only a thousand or so travelers annually arrange for the special permits and native guides required in order to visit. The trek is hardly a casual one.

Baja's main highway is in places merely a narrow strip of asphalt barely wider than two large trucks. The often unguarded road shoulders are littered with the carcasses of vehicles and livestock, and are decorated



Above: Cygnus, Aquila, and Delphinus
JERRY SCHAD
(24mm lens at f/1.7, Ektachrome P1600 film at ISO 3200, 25-second exposure)

Below: Canis Major Echoes a Pictograph
JERRY SCHAD
(24mm lens at f/1.7, Ektachrome P1600 film at ISO 3200, 30-second exposure)



with shrines to the highway's many victims.

From the highway, a 25-mile journey over an unpaved road laden with suspension-busting rocks took us to the isolated mountain villages of Rancho San Francisco de Sierra and Rancho Guadalupe. There, we joined local guides for the daylong hike down into the canyon system harboring the many ancient pictograph galleries.

It's a rugged and wild area. Our two guides rode mules over the perilous terrain, and five burros carried our camping gear.

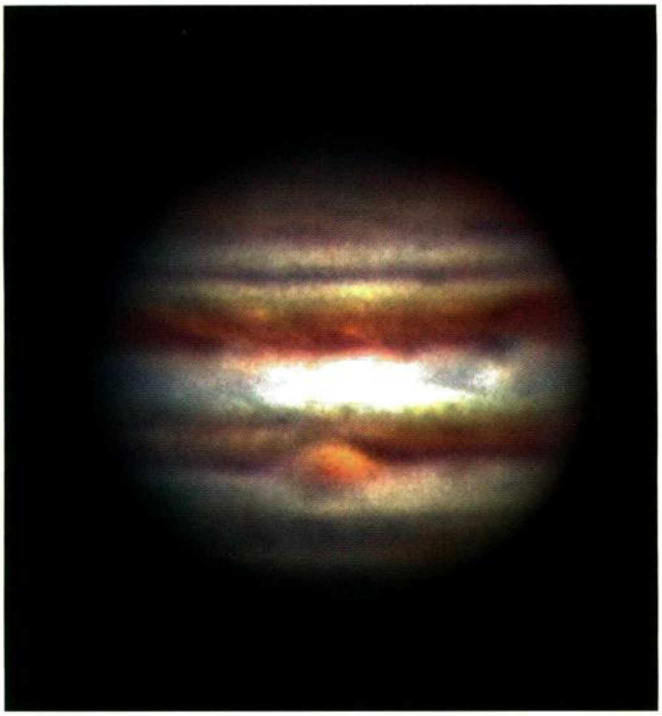
Sadly, of these five animals, only four returned; one suffered a near-fatal attack by a mountain lion foraging for food near our campsite and had to be put to death.

We spent the next few days exploring the various pictograph-decorated overhangs, known as "cuevas." (Spanish for caves.)

The best of these, Cueva La Pintada, in the Cañon de Santa Teresa of the Sierra de San Francisco mountains, features a jumbled array of human and animal (terrestrial, aerial, and aquatic) figures stretching some 500 feet. The paintings are found on rock faces that begin 20 feet or more above the ground.

One evening during moonrise I returned to Cueva La Pintada to obtain wide-angle photographs of pictographs alongside the starry sky.

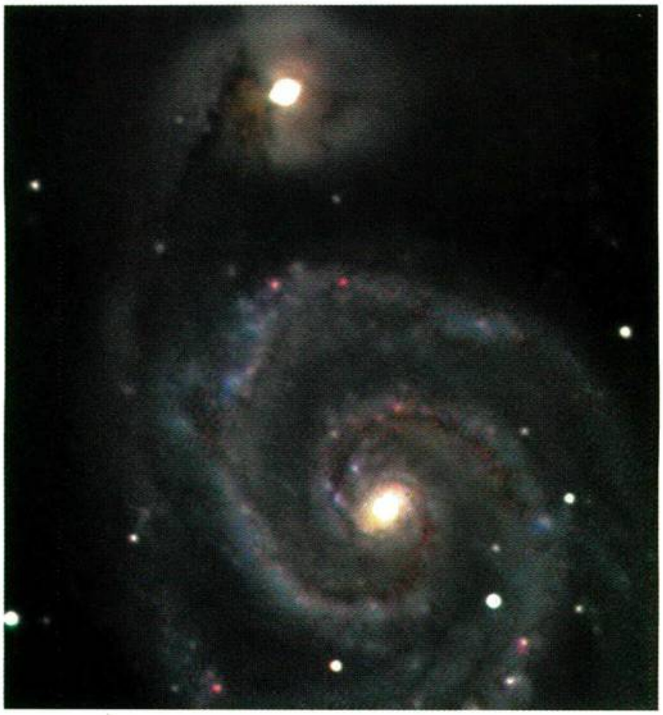
An especially compelling scene greeted me at the far end of one ancient mural array — a painted deer with antlers stretching up and to the left was mirrored on the right by the figure of Canis Major embedded in moonlit cirrus clouds. Between the two animals hovered the



Jupiter

MIKE FULLER

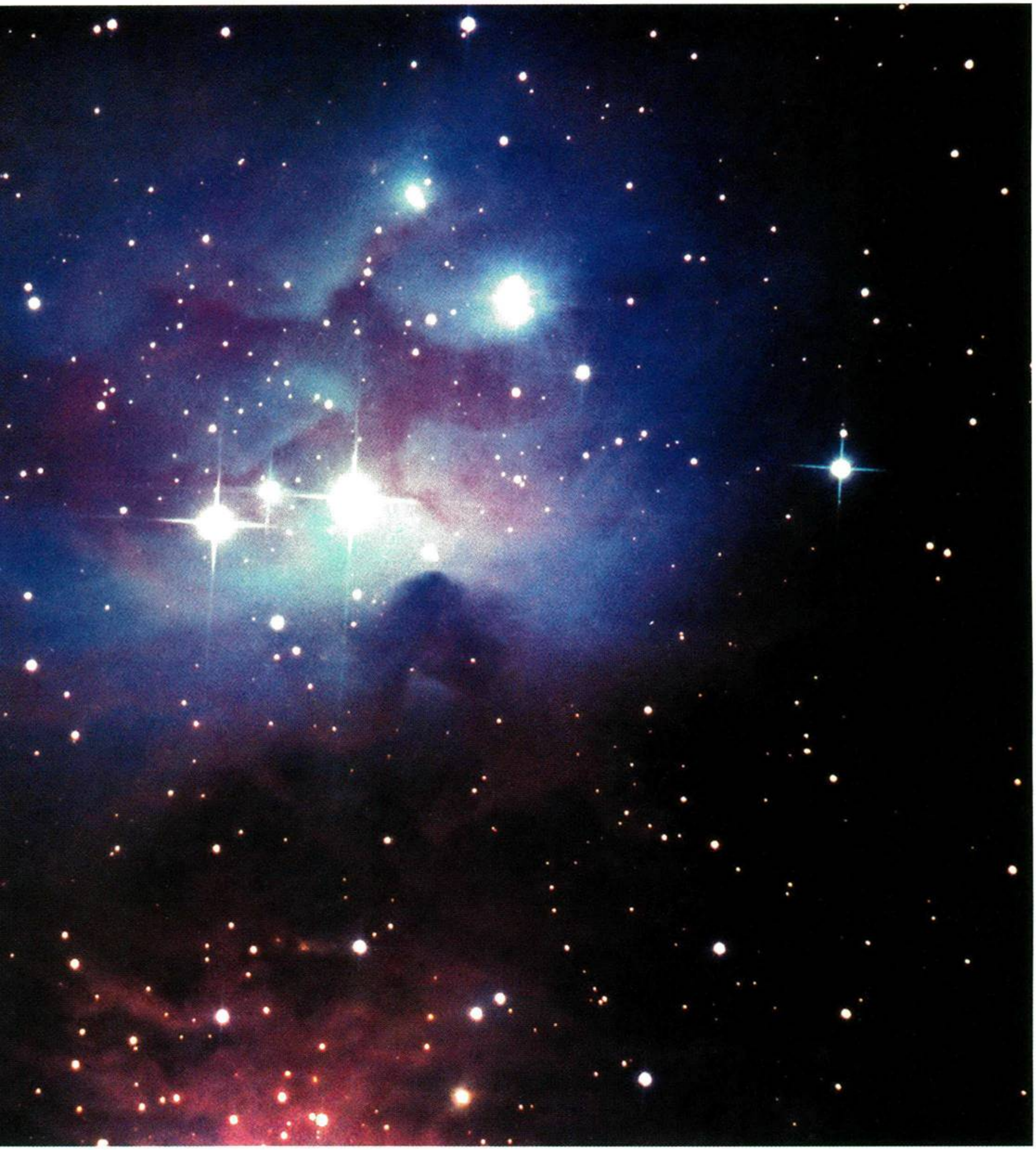
(12-inch SCT at f/22.5, Pictor 416XTE CCD camera, 2-second exposure, taken November 28, 2000)



The Whirlpool Galaxy (M51)

CHRIS SCHUR

(12.5-inch home-built Newtonian, SBIG 237 CCD camera, composite of four exposures)



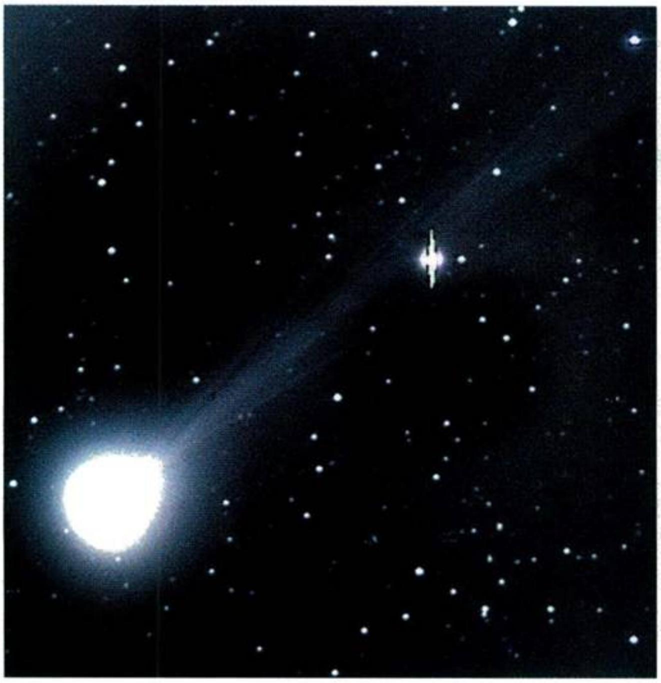
Reflection Nebula NGC 1973-5-7 in Orion

BOBBY MIDDLETON

(12.5-inch reflector at f/7, hypered Kodak PJ400 film, composite of two 60-minute exposures) ghostly outline of a human figure, topped by a shamanistic headdress.

The following night, around 3 A.M., I enjoyed a final leisurely photo session amid a cluster of 15-to-20-foot tall cardon cacti. Remnants of cactus flower buds were visible on the very tips of the highest stalks — and above them, Cygnus, Aquila, and Delphinus spangled the sky. — *Jerry Schad, of San Diego, California, specializes in landscape astrophotography* ■

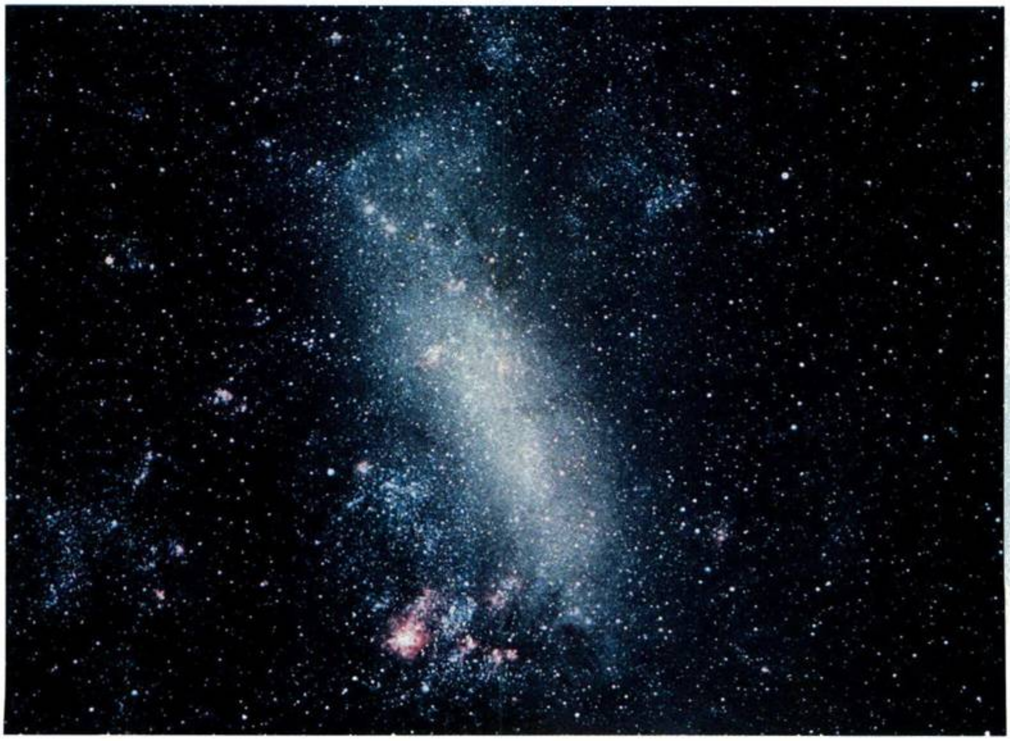
Share Your Stories
Send your 500- to 800-word reports describing your observing experiences to:
Hot Shots, *Astronomy* **magazine, P.O. Box 1612, Waukesha, WI 53187-1612**
Or e-mail them to:
hotshots@astronomy.com



Comet LINEAR

BILL HOLLENBACH AND ALEX RICHTER

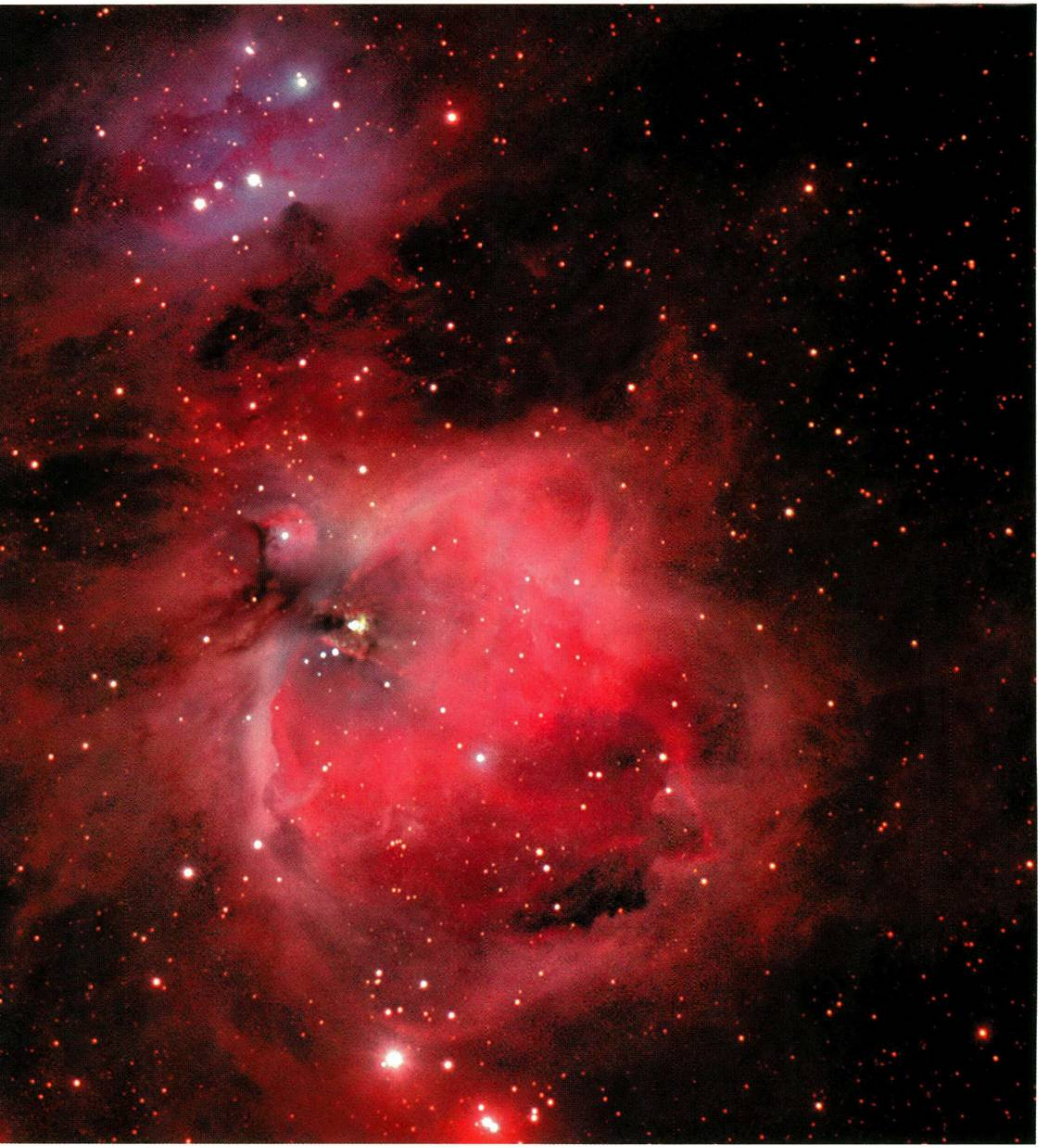
(16-inch SCT, Apogee 7 CCD camera, composite of three 30-second exposures, taken August 5, 2000)



The Large Magellanic Cloud

LUKE DODD

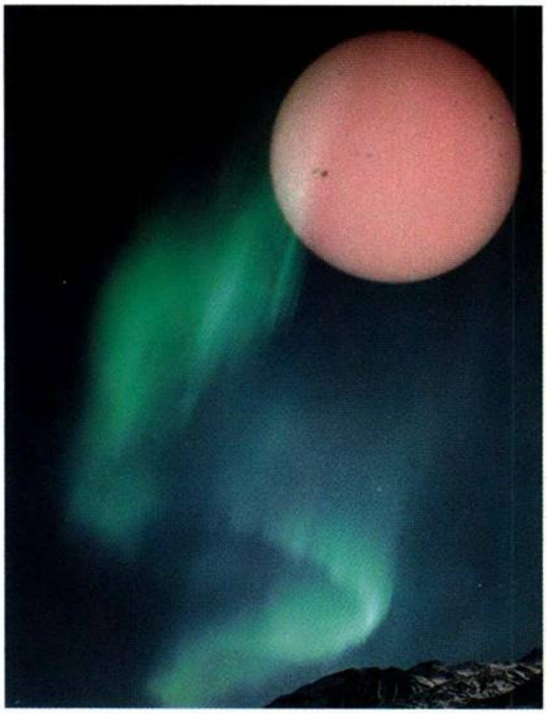
(300mm lens at f/4, hypered Fuji 400 film, composite of two 20-minute exposures)



The Orion Nebula (M42)

JASON WARE

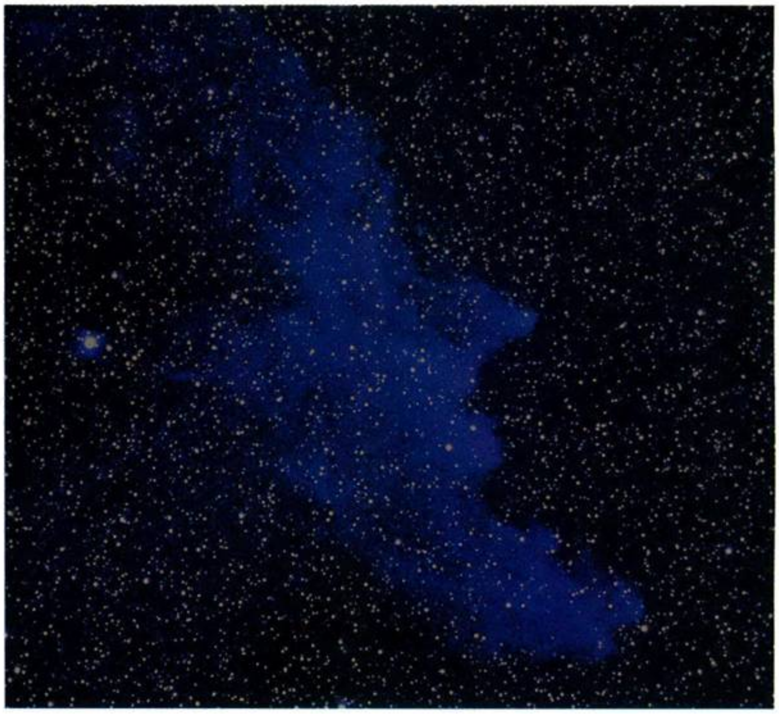
(5-inch refractor, Kodak PPF 400 film, two 40-minute exposures. Background enhanced by replacing red channel with Kodak Tech Pan #92 red filter using a 12/16-inch telescope at f/2.2)



Sunspot # 9415 Causes Aurora on April 8, 2001

MICHAEL KLENSCH

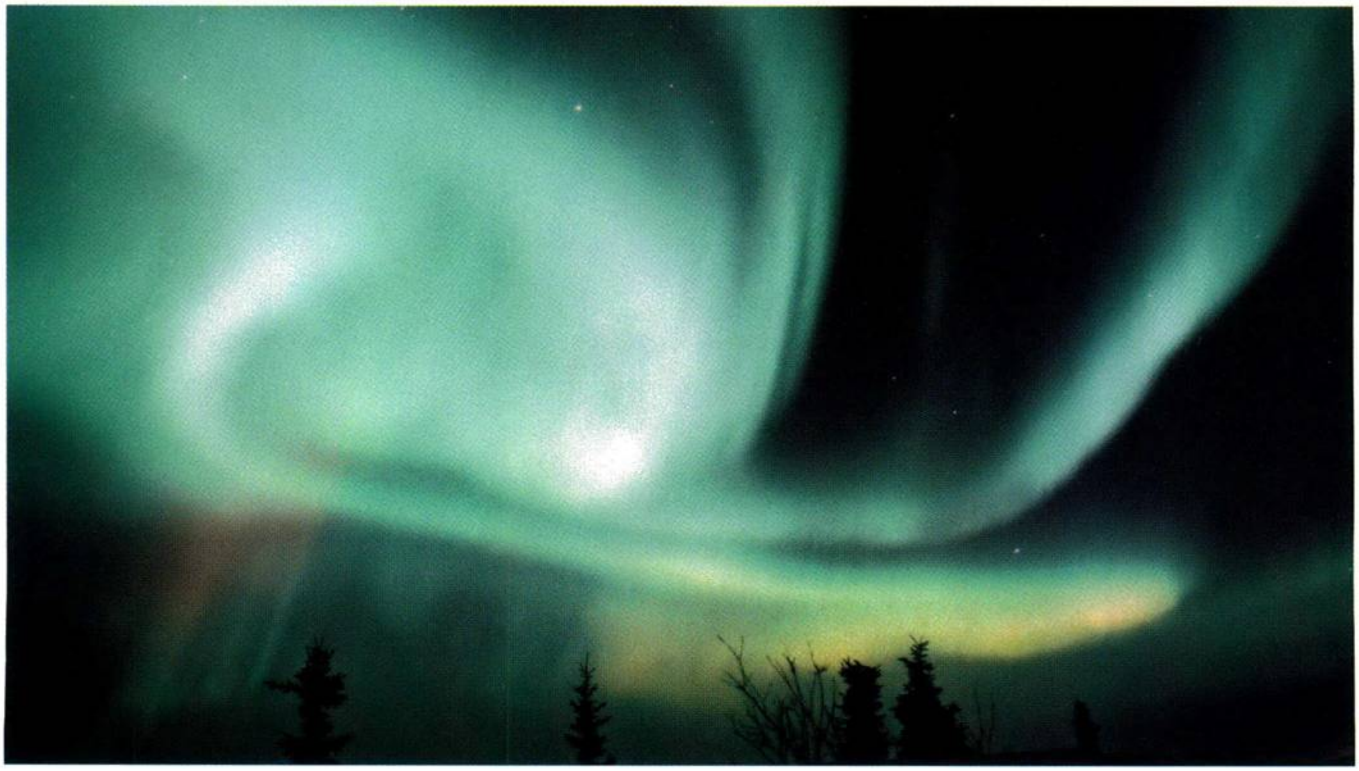
(CME April 6, 2001; aurora near White Pass, Alaska)



Witch Head Nebula

GEORGE GREANEY

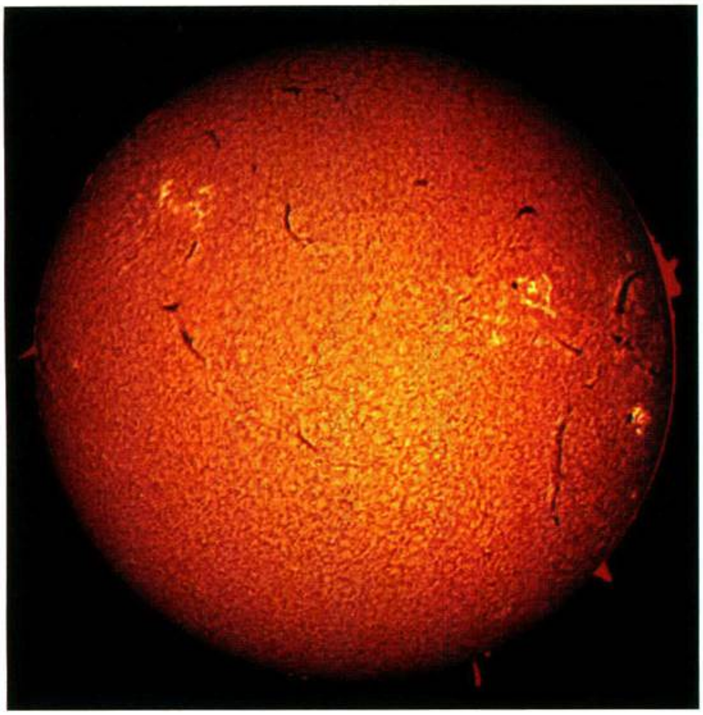
(6-inch f/7.1 refractor, hypered Fuji Super HG400 film, two one-hour exposures)



Donald Duck Aurora Pattern

MICHAEL J. O'LEARY

(24mm lens at f/2.0, Fuji 800 Superia film, 20-second exposure, taken March 20, 2001, 20 miles north of Fairbanks, Alaska)



Solar Details

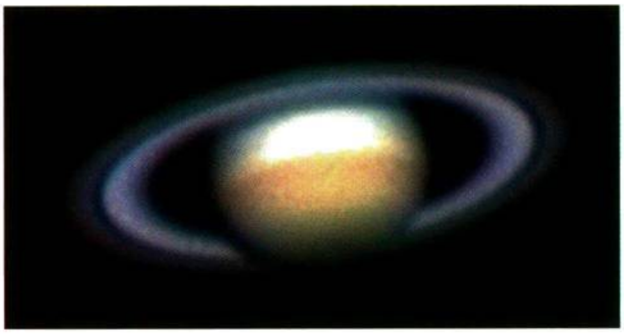
JEFFREY PETTITT

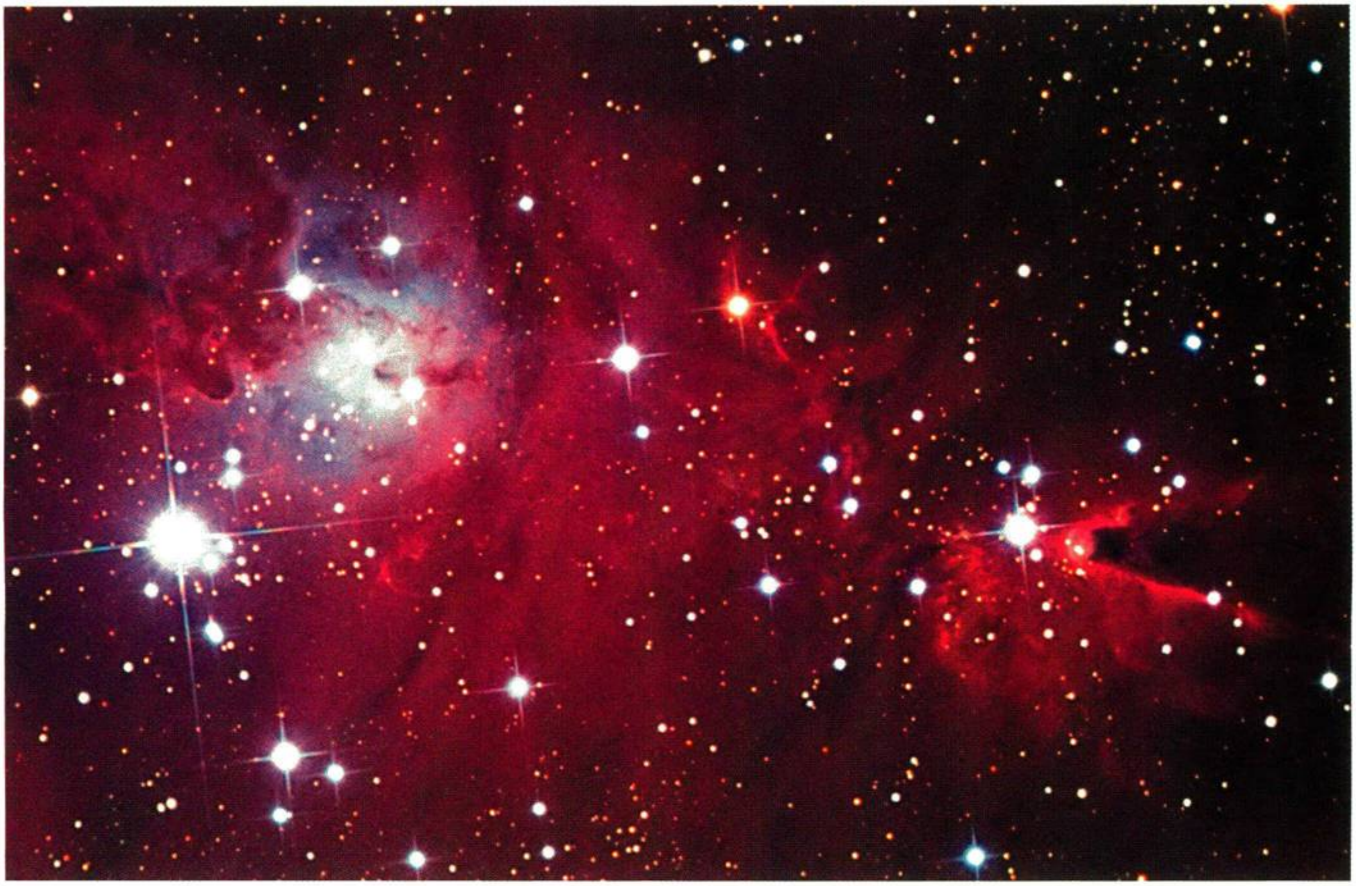
(Daystar H-α 0.6 angstrom filter, composite of 1/250-second and 1/8-second exposures, taken May 19, 2001)

Saturn

MIKE FULLER

(12-inch SCT at f/22.5, Pictor 416XTE CCD camera, 4-second exposure, taken November 28, 2000)

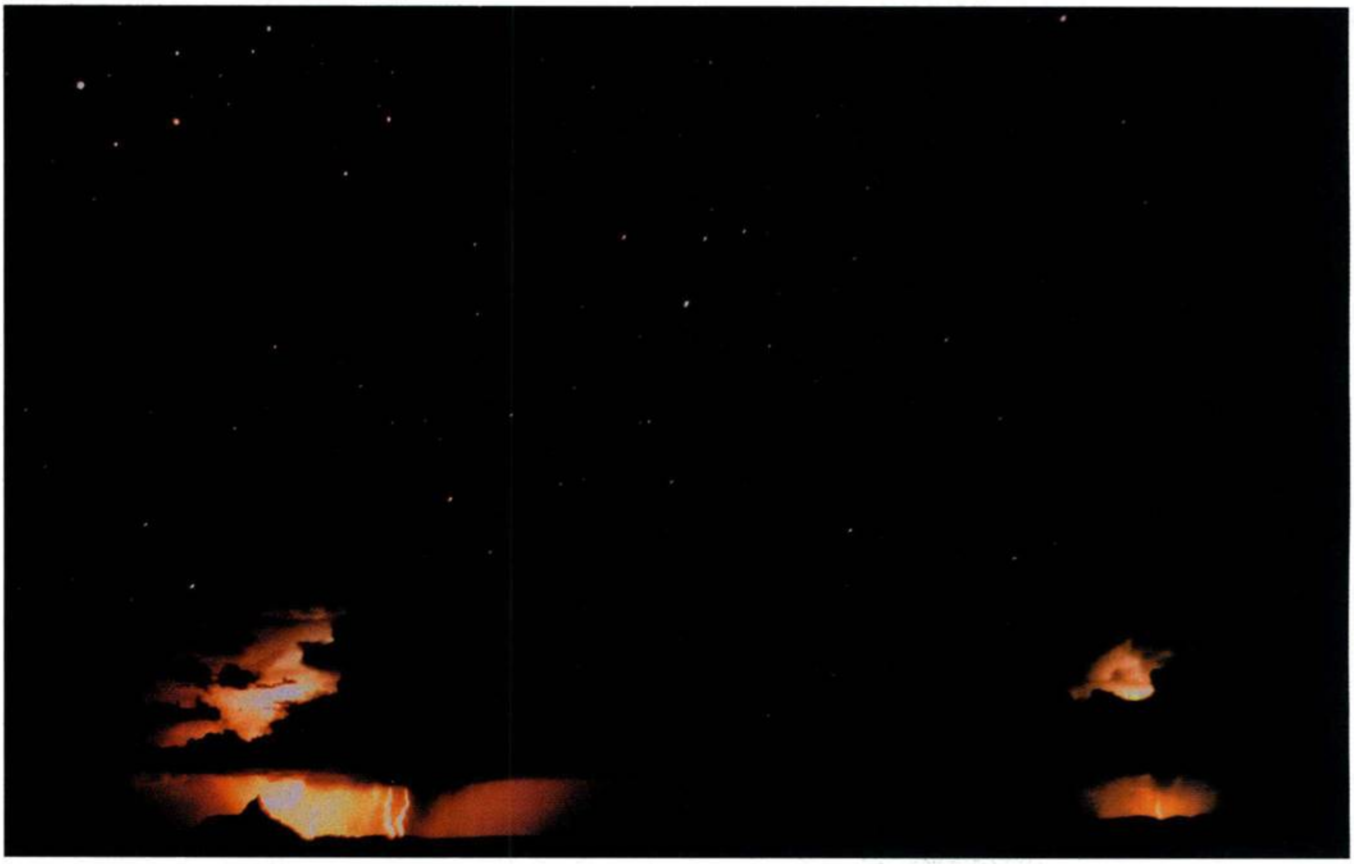




The Cone Nebula (NGC 2264)

JAMES R. FOSTER

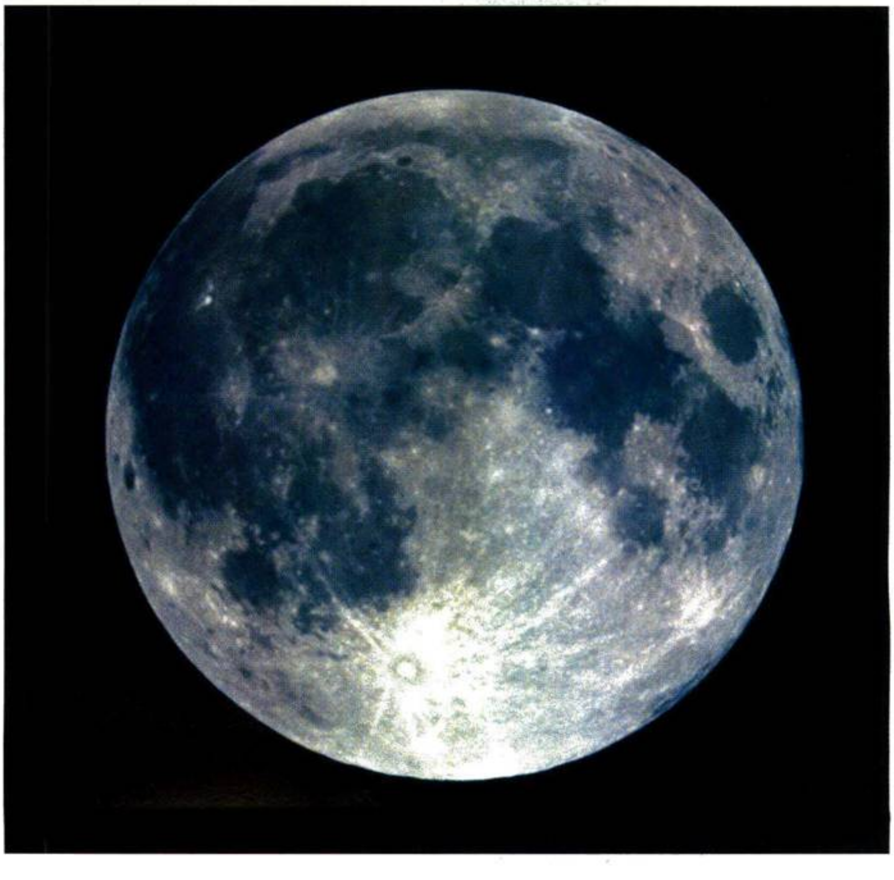
(13.1-inch SCT at f/7.5, composite of 147-minute, 93-minute, and 90-minute exposures on hypered Kodak PPF film, and a 120-minute exposure on hypered Kodak 2415 film)



Stars Above Lightning

ROBERT E. ALEXANDER

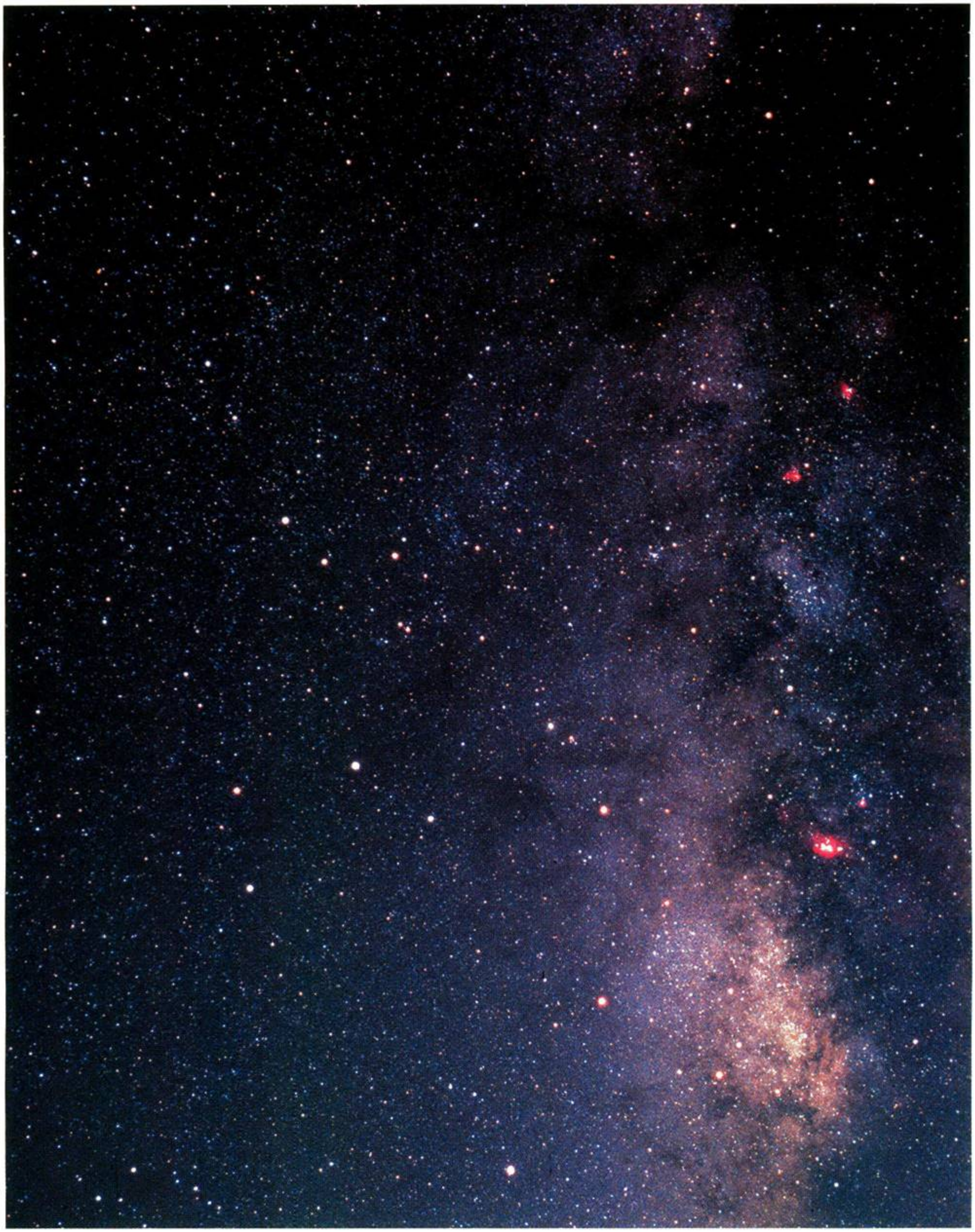
(210mm lens at f/4, Fuji Superia 800 film, 25-second exposure, taken from the south rim of the Grand Canyon, September 28, 2000)



Blue Moon

JOHN CHUMACK

(10-inch SCT at f/6.3, 80A blue filter, Kodak Royal Gold ISO 25 film, 1/500-second exposure, taken in August 1998)

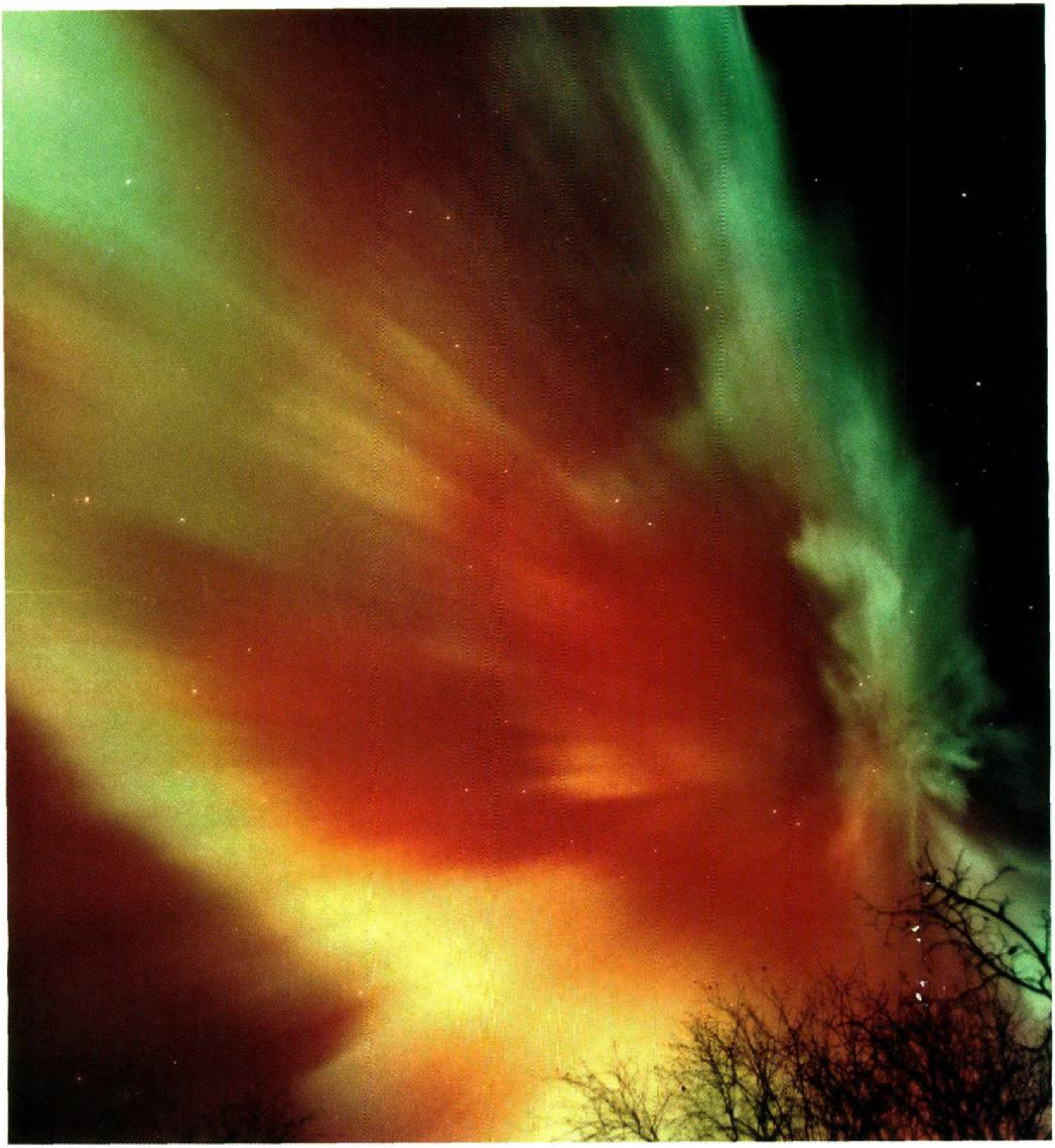


Milky Way

ALBERTO LEVY

(50mm lens at f/4, Kodak Ektachrome E-200 professional slide film, 25-minute exposure)

This month's best astrophoto



Aurora Burst at –30° F

MICHAEL J. O'LEARY

(24mm lens at f/2.0, Fuji 800 Superia film, 15-second exposure, taken five miles north of Fairbanks, Alaska, on March 24, 2001)

A Midsummer Night's Dream

Orion® SkyQuest™ XT Dobsonian Telescopes

In summer, the night sky beckons. The Milky Way tantalizes with myriad treasures scattered across a glitter of diamond dust. The Andromeda Galaxy, the Wild Duck Cluster, the Lagoon Nebula, the Ring...too many to count.

Discover anew the pleasures of a midsummer night with a modern classic, the SkyQuest XT telescope. Choose from the XT4.5, a REAL telescope for kids (and adults), the XT6, one of the finest beginner's telescopes a little money can buy, or the XT8, winning rave reviews from experts and astronomy buffs alike.

You'll be rewarded with bold, crisp views along with simple, hassle-free operation and a list of features that make other Dobs pale by comparison.

Your midsummer night's dream can come true, with an Orion SkyQuest XT.

SkyQuest DOBSONIAN
ORION
XT4.5
SkyQuest DOBSONIAN
ORION
XT6
SkyQuest DOBSONIAN
ORION
XT8

ORION
TELESCOPES & BINOCULARS

Our 26th Year!

ORION
AstroView 120
The Long & Short of It
Save $80
New!
telescope.com

Everything for the Amateur Astronomer—Delivered Direct

FREE 100-PAGE CATALOG. Call toll-free (800)447-1001
Or, visit us online at telescope.com

Selected Orion products are also available at authorized astronomical dealers.

LX90

MEADE

8" LX90

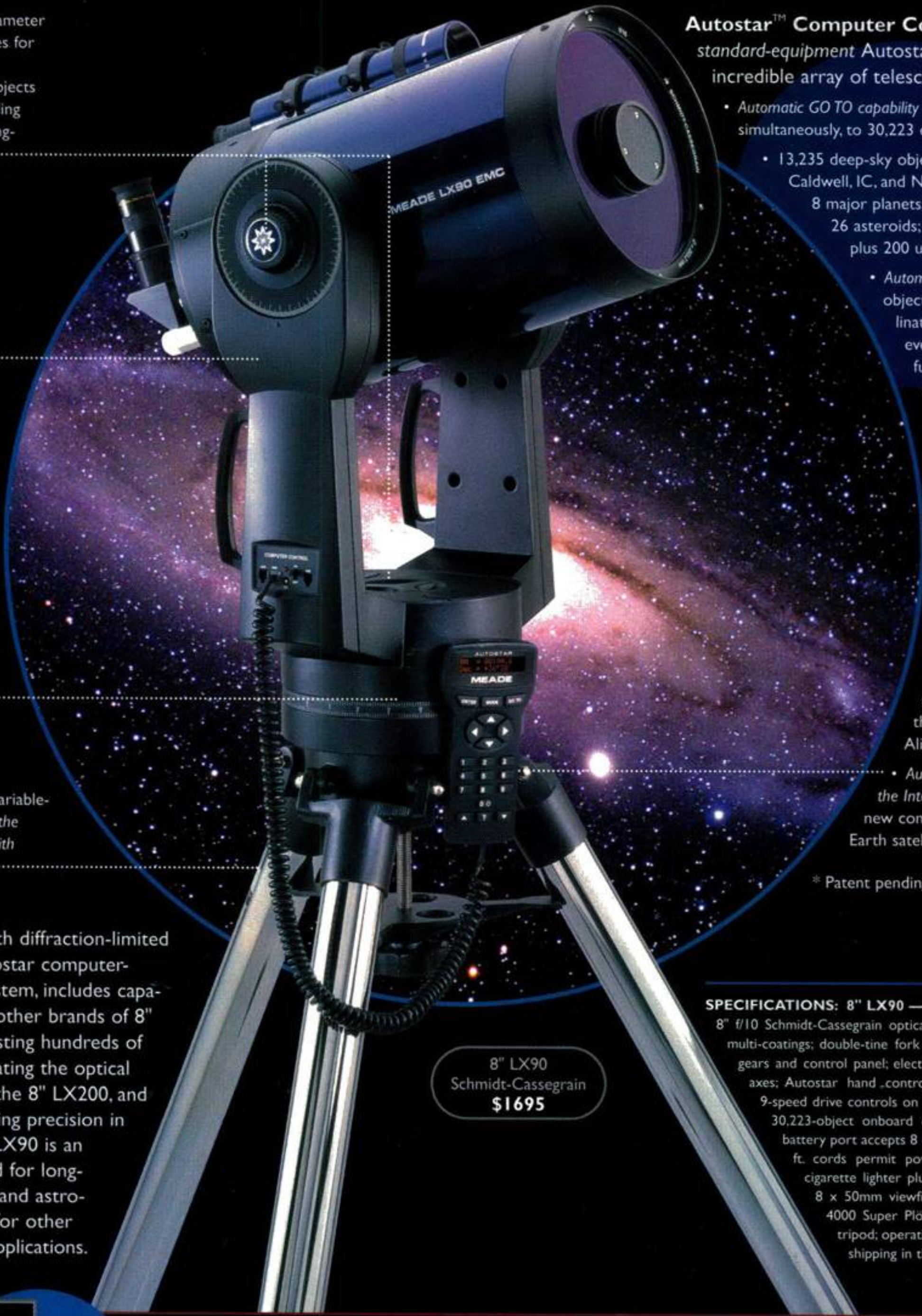
THE TELESCOPE OF A LIFETIME

Worm gears of 4.9"-diameter on both telescope axes for smooth sidereal-rate tracking of celestial objects as well as precise guiding corrections during long-exposure imaging.

Die-cast-aluminum *double-tine* fork mount that rigidly supports the optical tube in all sky orientations.

The LX90 is powered by C-cell batteries. Alternately, the telescope may be powered from an automobile cigarette lighter plug or from a standard 115vAC home outlet, using optionally available power cords.

Rigid chromed-steel variable-height field tripod — *the same tripod provided with Meade LX200 models.*



Autostar™ Computer Controller: The LX90's *standard-equipment* Autostar controller permits an incredible array of telescope features:

- *Automatic GO TO capability* at 6.5°/sec on both axes, simultaneously, to 30,223 database objects, including:
  - 13,235 deep-sky objects — the complete Messier, Caldwell, IC, and NGC catalogs; 16,888 stars; the 8 major planets; the Moon; 26 asteroids; 15 comets; 50 Earth satellites; plus 200 user-defined memory locations.
- *Automatic GO TO capability* to *any* object of known R.A. and Declination. Plus hundreds of special event menus, guided tours, utility functions, and telescope status options.
- *Nine selectable slew speeds:* 6.5°/sec, 3°/sec, and 1.5°/sec, as well as 128x, 64x, 16x, 8x, 2x, and 1x sidereal.
- *Control of the telescope* through your personal computer. (Requires optional #505 Connector Cable Set.)
- *Fast alignment of the telescope* using any of three alignment functions, including the Meade-proprietary Easy Align*.
- *Autostar is fully upgradeable over the Internet:* add the positions of new comets, update the positions of Earth satellites, even add new software.

* Patent pending

The Meade 8" LX90, with diffraction-limited Meade optics in an Autostar computer-controlled telescope system, includes capabilities not available on other brands of 8" Schmidt-Cassegrains costing hundreds of dollars more. Incorporating the optical system and coatings of the 8" LX200, and with 5 arc-minute pointing precision in the GO TO mode, the LX90 is an instrument fully qualified for long-exposure CCD imaging and astrophotography as well as for other advanced photo-visual applications.

8" LX90
Schmidt-Cassegrain
$1695

SPECIFICATIONS: 8" LX90 — Each complete telescope includes 8" f/10 Schmidt-Cassegrain optical tube assembly with EMC super multi-coatings; double-tine fork mount with dual-axis 4.9" worm gears and control panel; electric slow-motion controls on both axes; Autostar hand controller with digital readout display, 9-speed drive controls on both axes, and GO TO controller; 30,223-object onboard celestial software library; internal battery port accepts 8 (user-supplied) C-cells (optional 25 ft. cords permit powering from either 12vDC auto cigarette lighter plug or from 115vAC home outlet); 8 x 50mm viewfinder; 1.25" diagonal prism; Series 4000 Super Plössl 26mm eyepiece; standard field tripod; operating instructions. **$1695.** Packing & shipping in the 48 states: $95.

New 2001 126-page Meade General Catalog!

Call, write or fax for your free copy.

ADVANCED PRODUCTS DIVISION

Meade Instruments Corporation

The largest-selling telescopes in the world. ■ *A NASDAQ® company.*
6001 Oak Canyon, Irvine, California 92618 ■ (949) 451-1450
FAX: (949) 451-1460 ■ *www.meade.com*

© 2001